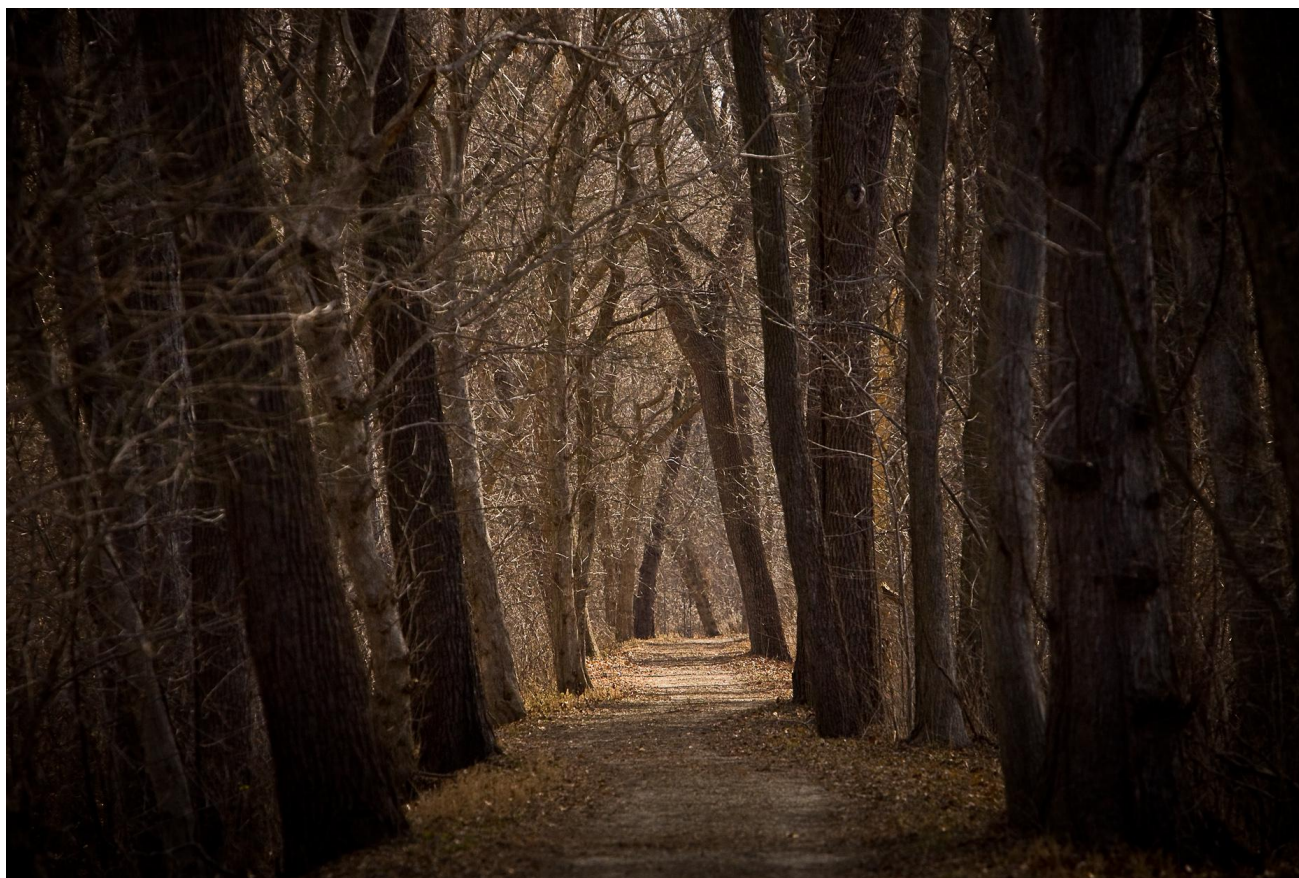




National Capital Region Network

2009 Forest Vegetation Monitoring Report

Natural Resource Data Series NPS/NCRN/NRDS—2010/043



ON THE COVER

Forest along C&O Canal near milepost 44.
Photograph by: Thomas Paradis, NPS.

National Capital Region Network

2009 Forest Vegetation Monitoring Report

Natural Resource Data Series NPS/NCRN/NRDS—2010/043

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U.S. Department of the Interior
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Executive Summary

This report presents a summary of the forest monitoring data collected in 2009 by the National Capital Region Network Inventory and Monitoring Program. The data collected is used for reporting on three vital signs: forest condition, exotic invasive plant species, and forest pests and diseases. Monitoring was conducted on 100 forest plots randomly located throughout the parks in the National Capital Region Network. This data is part of a long term forest monitoring effort that includes 400 forest plots. One hundred plots are monitored each year, and any particular plot will be monitored once every four years. As this is the first time that this particular set of one hundred plots has been monitored, only status data is available. Trend data will become available once repeat monitoring of the plots begins.

In 2009, monitoring took place in nine of the eleven parks of the network. The data collected includes information on the distribution, abundance and basal area of trees, saplings and seedlings and the quantity of coarse woody debris. Data was also collected on threats to the forest such as insect pests and exotic invasive plant species.

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Introduction

Forests are the predominant natural vegetation in the eleven parks which make up the National Capital Region Network (NCRN, Table 1). Although many of the parks protect cultural and historic resources and provide recreational opportunities, all eleven parks have significant forest resources. In some cases, such as battlefield parks, historic forests are a cultural as well as a natural resource in that they help park visitors understand the historic events that took place in the park.

In 2005, the Inventory and Monitoring program of the NCRN listed 21 priority “vital signs”, which are indicators of the state of natural resources in the NCRN parks (National Park Service 2005). Forest vegetation is one of these vital signs. The focus of this vital sign is to track changes in community composition, such as species composition, growth rates and mortality rates of forest plants.

Two additional vital signs, invasive plant species and forest insect pests and diseases, examine potential threats to forest vegetation and are included in this report. Invasive plant species can crowd out native vegetation and could lead to changes in community composition. Insect pests and diseases can reduce populations of individual plant species.

To address these vital signs, in 2006 the NCRN began a long term forest vegetation monitoring program. The monitoring program consists of taking measurements of forest vegetation on a series of randomly located plots (Schmit et al. 2009). The plots are modified versions of those used by the Forest Inventory Analysis program of the US Forest Service (Stolte et al. 2002).

This report summarizes the findings of forest vegetation monitoring at the regional and park levels for 2009. This is the fourth year of forest monitoring, and is the fourth year in a four year panel. Methods are the same as those used to monitor plots in 2006-8, with some exceptions. The diameter at root crown was measured for all shrubs in 2007 to 2009, as was decided after the 2006 monitoring.

Emerald ash borer has been added to the list of forest pests to monitor. Due to a lack of spruce trees, spruce budworm has been removed from the list. (Appendix A).

In 2009, Canadian serviceberry (*Amelanchier canadensis*) was encountered for the first time and added to the list of shrubs to monitor (Appendix B).

Two species were added to the list of exotic understory plants to monitor in 2009 (Appendix C). These species are marsh dewflower (*Murdannia keisak*) and wavyleaf basket grass (*Oplismenus undulatifolius*). Although they were already known to be present in the region, they were not encountered on the plots in previous years or in 2009.

As this is the first time this set of plots have been monitored, only status data is presented. Although some results, such as the presence of invasive species, are inherently undesirable, no formal assessment of the state of the parks is made in this report. The second round of sampling

of the plots will begin in 2010. At that time the NCRN will be able to begin to evaluate trends in forest communities.

All raw data is available in electronic form directly from the NCRN.

Methods

A summary of the methods used for forest monitoring is provided in this section. For more detailed information consult the NCRN forest monitoring protocol (Schmit et al. 2009).

Forest monitoring plots have been established throughout the eleven parks that make up the NCRN. Plot locations were selected using a randomized design known as “generalized random tessellation stratified” (GRTS; Stevens and Olsen 2004). A GRTS design gives the investigator a spatially balanced (not clumped) and random set of sampling sites. The output of a GRTS draw is an ordered list of potential plot locations. If some of the locations are not suitable they are eliminated and the next locations down the list are chosen instead without the loss of spatial balance or randomness. This is particularly useful in the National Capital Region where current vegetation maps are not available for all parks, and cultural, archeological or other concerns may preclude plot setup on otherwise suitable sites.

In order to choose locations for the forest plots, ArcMap 9.0 (ESRI Inc., Redlands, CA) was used to place a 250m grid over the entire region. Every intersection of the grid was a potential monitoring location. The 250m spacing was chosen as the NCRN will monitor forest birds at these locations, and bird monitoring points should be 250m apart (Dawson 2006). A GRTS draw was performed on this list of potential locations using S-Draw1b (West Inc 2005). As a result of this methodology the number of plots in each park over the 4 year sampling cycle will be approximately proportional to the forest area in each park. Starting in 2005, potential sampling locations were visited and unsuitable sites were eliminated from forest monitoring. In order to find 100 forest plot locations for 2009, 203 locations were considered, of which 103 locations were rejected. Locations were rejected for a variety of reasons including: being found in managed grasslands, roads or other non-forest habitat; being located off of park-owned property, or due to slopes steeper than 30°. After permits were obtained, plots were established at these locations and later measured by the seasonal monitoring crew (Table 1).

Table 1. Location and number of forest monitoring plots in 2009.

Park name	Park abbreviation	Plots monitored	Locations rejected
Antietam National Battlefield	ANTI	0	4
Catoctin Mountain Park	CATO	9	6
Chesapeake and Ohio Canal National Historical Park	CHOH	16 ¹	39
George Washington Memorial Parkway	GWMP	4 ¹	10
Harpers Ferry National Historical Park	HAFE	5	9
Manassas National Battlefield Park	MANA	2	2
Monocacy National Battlefield	MONO	1	6
National Capital Parks-East	NACE	12	18
Prince William Forest Park	PRWI	44	7
Rock Creek Park	ROCR	7	2
Wolf Trap National Park for the Performing Arts	WOTR	0	0

¹One plot located in the Great Falls area on the Maryland side of the Potomac Gorge is on land managed by CHOH but owned by GWMP. Results for this plot are reported under CHOH.

Plot Layout

Each forest monitoring location consists of a 15m radius circular plot with an area of 707 m² (Figure 1). All trees ≥ 10 cm dbh (diameter at breast height, 1.37 m) are identified, the diameter measured at breast height, tagged and mapped in the plot. Trees are marked at breast height with forestry paint so that future measurements will be made at the same location on the tree. Also recorded is the presence of vines on each tree, targeted insect pests and diseases (Appendix A), and other conditions that could increase tree mortality.

Within the main plot are three 3m radius circular microplots, with a combined area of 85m². All saplings (trees between 1 and 10 cm dbh) and shrubs are identified, measured and tagged on these microplots. Saplings are measured at breast height and shrubs are measured at the root crown. Shrubs are woody species that are generally multi-stemmed. In practice, the field crew is provided with a list of species which are to be measured as shrubs (Appendix B).

Three 15m long transects radiate out from the center to the edge of the plot, which are used for measuring coarse woody debris. All woody debris ≥ 7.5 cm diameter and 1 m length is measured and assigned a decay class.

Finally, 12 1m² quadrats (0.5 m x 2 m) are placed in the microplots and along the transects. Cover of select exotic and native herbaceous species (Appendix C) and seeding regeneration is measured in the quadrats.

Forest plot design and measurements are generally based on that of the US Forest Service Forest Inventory and Analysis Program (FIA), but modifications have been made. In general, the total area of the plot is nearly the same as that of the FIA plots (Stolte et al. 2002), but the NCRN plots are more compact. The more compact design was adopted as it is better suited to monitoring very small forest patches, which are often found in NCR parks.

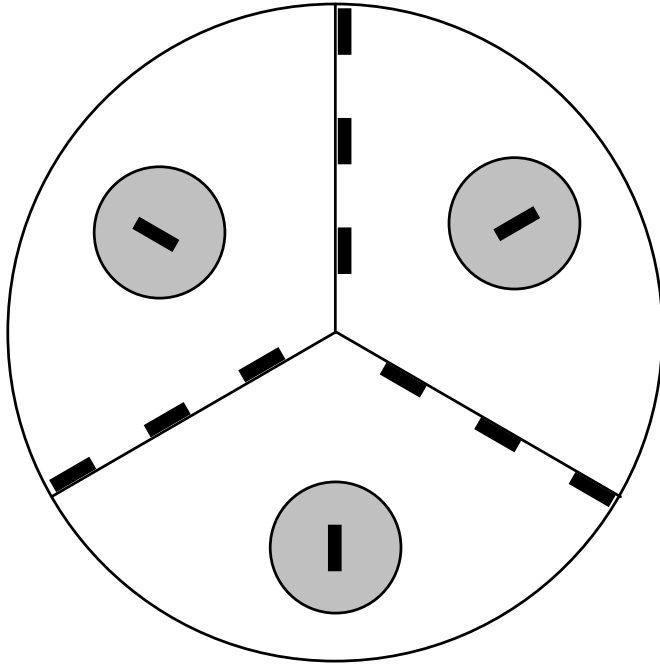


Figure 1. Layout of Forest Monitoring Plots. Trees are monitored within the 15m radius white circle. Saplings and shrubs are monitored within the 3m radius grey circles. Seedlings and select exotic and native herbaceous plants are monitored in the 1m² black quadrats. Coarse woody debris is measured on the 15m long transects emanating from the center of the plot.

Forest Communities in the National Capital Region

Tree Density and Basal Area

During 2009, a total of 2995 individual trees (dbh ≥ 10 cm) were tagged and measured (Table 2). Now that all 400 plots are installed, the NCRN is monitoring over 11,000 individual trees.

Table 2. Tree density, basal area (BA) and species richness by park.

Park	Plots	Trees	Trees/ha	BA(cm ² /ha)	Species	Species/Plot
CATO	9	180	283	366,000	20	7.0
CHOH	17	440	366	254,000	35	6.5
GWMP	3	48	226	278,000	13	6.3
HAFE	5	127	359	301,000	21	8.0
MANA	2	63	446	219,000	10	7.0
MONO	1	24	340	213,000	9	9.0
NACE	12	345	407	274,000	37	7.5
PRWI	44	1620	521	293,000	29	7.7
ROCR	7	148	299	386,000	22	8.0
Total	100	2995	424	295,000	64	7.4

The number of individual trees per plot varied from a high of 80 to a low of 9. Tree basal area on individual plots varied from a low of 4250 to a high of 56,100 cm²

In total, trees from 64 species were found in the region, with most parks having considerably fewer. The National Capital Parks East has the largest number of tree species. However, this year the highest average number of tree species per plot was found in the lone plot in Monocacy. The number of tree species on individual plots varied from 1 to 13.

Sapling Density and Basal Area

During 2009, a total of 885 saplings (trees between 1 and 10 cm dbh) were tagged and measured (Table 3). Now that all 400 plots are installed, the NCRN is monitoring over 3400 individual saplings.

In general, fewer saplings are monitored than trees. However, a smaller area is monitored for saplings (85 vs. 707m²), so on a per hectare basis saplings are more dense than trees. The number of saplings on an individual plot varied from six plots with zero to a single plot with 47.

Table 3. Sapling density, basal area (BA) and species richness by park.

Park	Plots	Saplings	Saplings/ha	BA(cm ²)/ ha	Species	Species/Plot
CATO	9	10	131	4820	6	0.8
CHOH	17	153	1060	16,600	16	1.7
GWMP	3	27	1060	14,800	8	3.3
HAFE	5	31	731	17,600	12	3.2
MANA	2	12	707	17,600	9	5.0
MONO	1	4	472	16,300	3	3.0
NACE	12	101	992	15,400	21	3.2
PRWI	44	481	1290	21,300	20	3.6
ROCR	7	66	1110	20,500	18	4.6
Total	100	885	1040	17,700	45	3.0

Only 45 sapling species were present on the plots as compared to 64 trees species. Fewer individual saplings than trees were monitored, which likely accounts for some of this difference. The number of sapling species on individual plots varied from 0 to 10. NACE had the largest number of sapling species.

Tree Seedling Density

During 2009, 606 seedlings (trees less than 1cm dbh and ≥ 15 cm height) were identified and their heights were measured (Table 4). We did not tag seedlings as this would be practically difficult and we expect them to have a high mortality rate.

Sixteen plots had no seedlings, and an additional thirteen plots had only one. The highest number of seedlings found on one plot was thirty in Prince William Forest Park. There is considerable variation in seedling density across the region, even in relatively well sampled parks. Seedling density was notably low in Catoctin.

A total of 38 tree species were found as seedlings on the plots, fewer than were found as mature trees. This is at least partially due to the fact that a smaller area was surveyed for seedlings and fewer individual tree seedlings were found than trees. The highest seedling species richness, 7 species, was found on two plots in Prince William Forest Park.

Table 4. Tree seedling density and richness by park.

Park	Plots	Seedlings	Seedlings/ha	Species	Species/Plot
CATO	9	3	278	3	0.3
CHOH	17	143	7010	16	2.3
GWMP	3	19	5280	6	2.0
HAFE	5	20	3330	4	1.2
MANA	2	-	-	-	-
MONO	1	12	10,000	1	1.0
NACE	12	95	6600	24	3.0
PRWI	44	297	5620	21	2.5
ROCR	7	17	2020	12	2.0
Total	100	606	5150	38	2.1

Tree Species Diversity

Across the region, 67 species were found as trees, saplings and/or seedlings (Table 5). While most of these species were found in all three growth states, a large minority were found in only one or two. It is not uncommon for a species to be common in one growth state, but rare in another. For example, Virginia pine (*Pinus virginiana*) is one of the most common species in terms of individual trees. It is nearly absent in the sapling layer, as it only establishes in early successional forests (Burns and Honkala 1990), which were found on few plots. Pawpaw (*Asimina triloba*) is relatively rare as a large tree, but is a common species in both the sapling and seedling layer.

Table 5. Tree species found on the forest monitoring plots.

Latin Name	Common Name	Trees	Tree Basal Area cm ² /ha	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	142	6680	17	579	69
¹ <i>Acer platanoides</i>	Norway maple	6	128	1	5	-
<i>Acer rubrum</i>	red maple	308	17,300	52	1900	4
<i>Acer saccharinum</i>	silver maple	36	7610	-	-	2
<i>Acer saccharum</i>	sugar maple	21	1010	7	184	-
¹ <i>Ailanthus altissima</i>	tree of heaven	13	388	4	95	-
<i>Amelanchier arborea</i>	common serviceberry	-	-	2	29	11
<i>Asimina triloba</i>	pawpaw	25	465	152	1670	100
<i>Betula lenta</i>	sweet birch	11	1530	-	-	-
<i>Betula nigra</i>	river birch	-	-	-	-	1
<i>Carpinus caroliniana</i>	American hornbeam	2	23	21	404	6
<i>Carya alba</i>	mockernut hickory	27	1360	9	264	2
<i>Carya cordiformis</i>	bitternut hickory	13	2080	-	-	12
<i>Carya glabra</i>	pignut hickory	73	5140	15	324	9
<i>Carya ovalis</i>	red hickory	20	1590	3	45	-
<i>Carya ovata</i>	shagbark hickory	1	62	-	-	-
<i>Celtis occidentalis</i>	common hackberry	16	790	8	271	9
<i>Cercis canadensis</i>	eastern redbud	2	50	3	94	1
<i>Cornus florida</i>	flowering dogwood	25	380	32	803	-
<i>Crataegus crus-galli</i>	cockspur hawthorn	-	-	2	57	-
<i>Diospyros virginiana</i>	common persimmon	3	147	-	-	-
<i>Fagus grandifolia</i>	American beech	300	16,500	193	3320	32
<i>Fraxinus americana</i>	white ash	63	7720	11	440	19
<i>Fraxinus pennsylvanica</i>	green ash	15	629	3	20	6
<i>Fraxinus profunda</i>	pumpkin ash	3	78	3	38	-
<i>Gleditsia triacanthos</i>	honey locust	2	162	-	-	1
<i>Ilex opaca</i>	American holly	67	1340	60	1210	62
<i>Juglans nigra</i>	black walnut	22	2010	2	98	1
<i>Juniperus virginiana</i>	eastern red cedar	19	644	1	28	2
<i>Liquidambar styraciflua</i>	sweetgum	56	4180	20	332	18
<i>Liriodendron tulipifera</i>	tulip poplar	472	73,600	19	382	-
¹ <i>Malus</i> spp.	Apple	-	-	1	2	3
¹ <i>Morus alba</i>	white mulberry	7	505	-	-	-
<i>Nyssa sylvatica</i>	blackgum	181	5310	87	2830	7
<i>Ostrya virginiana</i>	hop hornbeam	10	167	2	73	-
¹ <i>Paulownia tomentosa</i>	princess tree	1	292	-	-	-
<i>Pinus echinata</i>	shortleaf pine	1	103	-	-	-
<i>Pinus rigida</i>	pitch pine	2	332	-	-	-
<i>Pinus strobus</i>	white pine	2	812	-	-	-
<i>Pinus virginiana</i>	Virginia pine	328	32,100	1	32	7
<i>Platanus occidentalis</i>	American sycamore	6	1990	1	70	-

Table 5. Tree species found on the forest monitoring plots (continued).

Latin Name	Common Name	Trees	Tree Basal Area cm ² /ha	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Populus deltoides</i>	eastern cottonwood	6	4520	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	2	275	1	38	1
<i>Prunus serotina</i>	black cherry	45	2690	9	309	19
¹ <i>Pyrus betulifolia</i>	birch-leaf pear	1	90	-	-	-
¹ <i>Pyrus calleryana</i>	Callery pear	-	-	3	28	7
¹ <i>Pyrus communis</i>	common pear	1	30	-	-	-
<i>Quercus alba</i>	white oak	219	29,400	80	459	106
<i>Quercus coccinea</i>	scarlet oak	52	8730	4	32	7
<i>Quercus falcata</i>	southern red oak	46	6450	17	83	15
<i>Quercus muehlenbergii</i>	chinkapin oak	3	419	-	-	-
<i>Quercus palustris</i>	pin oak	4	697	1	4	1
<i>Quercus phellos</i>	willow oak	13	2200	2	94	2
<i>Quercus prinus</i>	chestnut oak	62	8610	3	70	4
<i>Quercus rubra</i>	northern red oak	77	18,000	4	231	7
<i>Quercus shumardii</i>	Shumard's oak	2	673	1	65	-
<i>Quercus stellata</i>	post oak	10	1010	1	5	-
<i>Quercus velutina</i>	black oak	35	6590	9	143	24
<i>Quercus X benderi</i>	Bender oak	1	180	-	-	-
<i>Quercus X willdenowiana</i>	Willdenow's oak	1	310	-	-	-
<i>Quercus</i> spp.	Oak	1	186	-	-	-
<i>Robinia pseudoacacia</i>	black locust	39	2590	-	-	2
<i>Salix nigra</i>	black willow	1	125	-	-	-
<i>Sassafras albidum</i>	Sassafras	23	1700	6	187	22
<i>Tilia americana</i>	American basswood	10	1240	-	-	-
<i>Ulmus americana</i>	American elm	25	1240	-	-	-
¹ <i>Ulmus pumila</i>	Siberian elm	2	90	-	-	-
<i>Ulmus rubra</i>	slippery elm	6	613	3	136	1

¹Non-native species.

Shrub Density

During 2009, a total of 483 individuals from 15 shrub species (typically multi-stemmed with a diameter at root crown ≥ 1 cm [Appendix B]) were tagged and measured on the microplots in each plot (Table 6). Now that all 400 plots are installed, the NCRN is monitoring over 2100 shrubs. Some species that are commonly considered shrubs, such as multi-flora rose (*Rosa multiflora*) often grow as a dense cover that makes it difficult to delineate individual plants. These species are monitored by measuring their cover on the quadrats, as it is impractical to tag and measure individuals. Shrubs are much less common than trees; 54 plots did not contain any shrubs.

Shrub richness per plot is considerably lower than that of trees. Only six plots contained more than two shrub species.

Table 6. Shrub density and species richness by park.

Park	Plots	Shrubs	Shrubs per ha	BA(cm ²)/ha	Species	Species/ Plot
CATO	9	52	681	98,200	1	0.3
CHOH	17	31	215	25,700	3	0.7
GWMP	3	20	786	31,500	2	1.3
HAFE	5	17	401	81,500	3	1.0
MANA	2	-	-	-	-	-
MONO	1	-	-	-	-	-
NACE	12	117	1150	64,500	9	1.1
PRWI	44	235	630	39,600	7	0.7
ROCR	7	11	185	16,500	2	0.3
Total	100	483	569	44,500	15	0.7

Shrub Seedling Density

A total of 372 shrub seedlings were found across all of the plots, far fewer than the number of tree seedlings found (Table 7). Only 44 plots had shrub seedlings present. Shrub seedling density varied greatly across parks.

Nineteen different shrubs were present as seedlings (Table 8).

Table 7. Shrub seedling density and species richness by park.

Park	Plots	Seedlings	Seedlings/ha	Species	Species/Plot
CATO	9	90	8330	1	0.3
CHOH	17	89	4360	5	0.8
GWMP	3	22	6110	2	1.0
HAFE	5	10	1670	1	0.4
MANA	2	3	1250	1	0.5
MONO	1	-	-	-	-
NACE	12	41	2850	8	0.9
PRWI	44	74	1400	9	0.5
ROCR	7	43	5120	4	1.3
Total	100	372	3100	19	0.6

Shrub Species Diversity

Two shrub species, northern spicebush (*Lindera benzoin*) and mountain laurel (*Kalmia latifolia*) make up over 60% of individual shrubs (Table 8). Northern spicebush also accounted for almost 60% of all shrub seedlings. The other native species are relatively uncommon across the region.

Table 8. Shrub species found on the forest monitoring plots.

Latin Name	Common Name	Shrubs	Seedlings
<i>Amelanchier canadensis</i>	Canadian serviceberry	-	11
<i>Aralia spinosa</i>	devil's walkingstick	1	1
<i>Cornus amomum</i>	silky dogwood	5	-
¹ <i>Elaeagnus umbellata</i>	autumn olive	3	3
¹ <i>Euonymus alatus</i>	burning bush	1	3
<i>Euonymus americanus</i>	strawberry bush	-	3
<i>Hamamelis virginiana</i>	American witchhazel	6	5
<i>Ilex verticillata</i>	common winterberry	3	1
<i>Kalmia latifolia</i>	mountain laurel	172	16
¹ <i>Ligustrum vulgare</i>	European privet	3	3
<i>Lindera benzoin</i>	northern spicebush	122	222
¹ <i>Lonicera maackii</i>	Amur honeysuckle	78	14
<i>Lyonia ligustrina</i>	maleberry	1	24
<i>Rhododendron periclymenoides</i>	pinxter flower	-	1
¹ <i>Symphoricarpos orbiculatus</i>	coralberry	-	1
<i>Vaccinium corymbosum</i>	highbush blueberry	35	1
<i>Vaccinium fuscum</i>	black highbush blueberry	42	28
<i>Viburnum acerifolium</i>	mapleleaf viburnum	-	28
<i>Viburnum dentatum</i>	southern arrow wood	10	1
<i>Viburnum prunifolium</i>	blackhaw	1	6

¹Non-native species.

Coarse Woody Debris

Coarse woody debris (CWD) was measured using the line-intersect method (Van Wagner 1968) on three 15 m long transects in each plot. On average, there were 67.9 m³ per ha of CWD ≥ 7.5 cm diameter across all plots (Table 9). On one plot, CHOH-0075, CWD was not measured. This plot is located in floodplain of the Potomac. At the time the plot was monitored, a 2 meter high log jam had been deposited on the plot by high water. It was not possible to accurately measure this CWD, and we believe that the log jam is likely to be moved by any subsequent high water events.

Table 9. Mean coarse woody debris by park.

Park Code	Plots	Coarse woody debris m ³ /ha
CATO	9	75.4
CHOH	14	38.6
GWMP	3	78.0
HAFE	5	55.7
MANA	2	16.5
MONO	1	55.6
NACE	12	47.4
PRWI	44	90.7
ROCR	7	58.4
Total	100	67.9

Forest Pests and Diseases in the National Capital Region

Forest pests and diseases were selected as one of the 21 vital signs for the parks in NCRN. Forests in the parks have historically been impacted by pests such as the gypsy moth (*Lymantria dispar*), and diseases such as the chestnut blight. Trees on forest monitoring plots were monitored for a select group of pests and diseases (Appendix A). The list will be reviewed annually for appropriate additions or removals.

In 2009, gypsy moths and dogwood anthracnose were the only pest and disease species encountered. Gypsy moths were found on 14 trees, which is 0.5% of all monitored trees. Catocin had 4 infested trees and Harpers Ferry had 10 infested trees. Two tree species were impacted by gypsy moth. These include twelve trees of chestnut oak (*Quercus prinus*) and two trees of northern red oak (*Quercus rubra*).

Dogwood anthracnose was found in two parks, the C&O Canal, and Prince William Forest Park. In each park, only a single infected tree was found.

Exotic Plant Species in the National Capital Region

Many exotic plant species are found in the parks that make up the NCRN. Exotic plant species can exclude native species, may be less suitable for wildlife, and may have negative impacts on other aspects of the ecosystem such as soil quality.

The NCRN is measuring distribution and abundance of exotic plant species using the forest monitoring plots. Exotic trees, vines, shrubs and select herbaceous plants are monitored.

Exotic Tree Species

Of the 64 species found as trees, eight are not native to the region (Table 5). Combined these species are represented by 33 individual trees, which make up 1.1% of all trees and 0.6% of all tree basal area.

Five species found as saplings are not native to the region. Combined these species are represented by only ten individuals which make up 1.3% of all saplings and 0.9% of all sapling basal area.

Seedlings of three exotic species were found. Eleven individual seedlings were found, which represents 1.8% of all seedlings.

Based on the data collected in 2009, exotic tree species are present throughout the region but they represent a localized problem.

Vines in Trees

The NCRN does not tag and monitor individual vines. However, vines are identified when they grow on tagged trees. Vines are noted and identified regardless of whether they are herbaceous, wood, native, exotic, invasive, or non-invasive. Additionally, exotic vines which occur as cover on the quadrats are also monitored (see below).

In all, 604 trees, 20.2% of all marked trees, had vines growing on them (Table 10). Of these, 274 (9.1%) had vines growing in the crown of the tree. Vines that grow in the crowns of trees could increase tree mortality by shading leaves or toppling trees due to the increased weight. Vines in trees are particularly common in some parks, such as CHOH and NACE where forest edge is more common.

Table 10. Presence of vines in trees by park.

Park	Plots	Trees	Trees with Vines	Tree with vines in crown
CATO	9	180	24	19
CHOH	17	440	218	126
GWMP	3	48	8	1
HAFE	5	127	46	25
MANA	2	63	2	1
MONO	1	24	15	13
NACE	12	345	149	43
PRWI	44	1620	104	31
ROCR	7	148	38	15
Total	100	2995	716	274

Of the 21 species of vines found, eight were exotic species (Table 11). In total, there were 125 instances of exotic vines growing in trees and of these, 65 were exotic vines growing in the crown of the tree. Native species, including poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*) and wild grape (*Vitis* spp.) were also very common.

Table 11. Species of vines in trees.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Ampelopsis brevipedunculata</i>	porcelainberry	9	2
<i>Apios americana</i>	groundnut	2	-
<i>Campsis radicans</i>	trumpet creeper	3	2
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	28	27
¹ <i>Clematis terniflora</i>	sweet autumn clematis	4	-
¹ <i>Hedera helix</i>	English ivy	16	-
¹ <i>Humulus japonicus</i>	Japanese hop	2	-
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	52	30
<i>Menispermum canadense</i>	common moonseed	2	1
<i>Parthenocissus quinquefolia</i>	Virginia creeper	141	69
¹ <i>Polygonum perfoliatum</i>	mile-a-minute	3	2
¹ <i>Rosa multiflora</i>	multiflora rose	11	4
<i>Sicyos angulatus</i>	oneseed burr	1	1
	cucumber		
<i>Smilax glauca</i>	cat greenbrier	2	-
<i>Smilax rotundifolia</i>	round leaf greenbrier	178	32
<i>Toxicodendron radicans</i>	poison ivy	110	18
<i>Vitis aestivalis</i>	summer grape	58	51
<i>Vitis cinerea</i>	graybark grape	1	-
<i>Vitis labrusca</i>	fox grape	12	10
<i>Vitis riparia</i>	riverbank grape	1	1
<i>Vitis vulpina</i>	frost grape	164	143
<i>Vitis</i> spp.	grape	2	1

¹Non-native species.

Not all tree species were equally impacted by vines (Table 12). For twenty-two tree species, over 10% of all individual trees have vines in their crowns.

Table 12. Tree species affected by vines.

Tree Species	Trees	Trees with Vines	Trees with Vines in Crown
<i>Acer negundo</i>	142	56	31
¹ <i>Acer platanoides</i>	6	1	1
<i>Acer rubrum</i>	308	64	20
<i>Acer saccharinum</i>	36	19	9
<i>Acer saccharum</i>	21	2	2
¹ <i>Ailanthus altissima</i>	13	10	6
<i>Carya alba</i>	27	3	1
<i>Carya cordiformis</i>	13	5	3
<i>Carya glabra</i>	73	4	3
<i>Celtis occidentalis</i>	16	7	7
<i>Cornus florida</i>	25	2	2
<i>Diospyros virginiana</i>	3	3	2
<i>Fagus grandifolia</i>	300	19	3
<i>Fraxinus americana</i>	63	23	11
<i>Fraxinus pennsylvanica</i>	15	12	-
<i>Fraxinus profunda</i>	3	3	-
<i>Gleditsia triacanthos</i>	2	2	2
<i>Ilex opaca</i>	67	13	11
<i>Juglans nigra</i>	22	9	9
<i>Juniperus virginiana</i>	19	10	6
<i>Liquidambar styraciflua</i>	56	12	-
<i>Liriodendron tulipifera</i>	472	67	23
¹ <i>Morus alba</i>	7	7	4
<i>Nyssa sylvatica</i>	181	30	13
<i>Ostrya virginiana</i>	10	1	1
¹ <i>Paulownia tomentosa</i>	1	1	1
<i>Pinus virginiana</i>	328	38	2
<i>Platanus occidentalis</i>	6	4	1
<i>Populus deltoides</i>	6	6	-
¹ <i>Prunus avium</i>	2	2	2
<i>Prunus serotina</i>	45	30	24
¹ <i>Pyrus betulifolia</i>	1	1	-
¹ <i>Pyrus communis</i>	1	1	-
<i>Quercus alba</i>	219	12	3
<i>Quercus falcata</i>	46	4	1
<i>Quercus muehlenbergii</i>	3	1	-
<i>Quercus palustris</i>	4	4	-
<i>Quercus phellos</i>	13	6	1
<i>Quercus prinus</i>	62	17	6
<i>Quercus rubra</i>	77	5	2
<i>Quercus shumardii</i>	2	1	-
<i>Quercus stellata</i>	10	1	1
<i>Quercus velutina</i>	35	4	2
<i>Robinia pseudoacacia</i>	39	31	23
<i>Salix nigra</i>	1	1	-
<i>Sassafras albidum</i>	23	16	16
<i>Tilia americana</i>	10	2	1
<i>Ulmus americana</i>	25	12	5
¹ <i>Ulmus pumila</i>	2	2	1
<i>Ulmus rubra</i>	6	2	1

¹Non-native species.

Exotic Shrubs

Of the twenty shrub species found (Table 8), five are exotic. Amur honeysuckle (*Lonicera maackii*) was by far the most common, with 78 individual shrubs found in a single plot in NACE near the intersection of MD-50 and the Baltimore-Washington Parkway. In total, 85 exotic shrubs and 24 exotic shrub seedlings were found. These represent 17.6 % of all individual shrubs, and 6.5% of all shrub seedlings.

Exotic Herbaceous Plants

On each plot, 12 quadrats measuring 0.5×2m are surveyed for targeted exotic plants. These include herbaceous exotics as well as some vines and shrubs such as multi-flora rose (*Rosa multiflora*) which cannot practically be monitored by tagging individual plants. Of the 100 plots monitored in 2009, 58 had invasive species on at least 1 quadrat (Table 13). No park was free from such species. The percent of plots with herbaceous exotics varies considerably between parks, but only in Prince William Park was this less than 50%.

Table 13. Frequency of exotic herbaceous plants by park.

Park	Plots	Plots with exotic herbs	% of plots with exotic herbs	# of quadrats with exotics in plots with exotics
CATO	9	9	100%	8.3
CHOH	17	16	94%	11.4
GWMP	3	3	100%	5.0
HAFE	5	4	80%	5.5
MANA	2	2	100%	4.5
MONO	1	1	100%	11.0
NACE	12	8	67%	9.8
PRWI	44	8	18%	4.4
ROCR	7	7	100%	6.6
Total	100	58	58%	8.2

Twenty exotic plant species were detected on the quadrats (Table 14). While most of the species were not widespread, several are found on a large number of plots throughout the region.

The most common species include garlic mustard (*Alliaria petiolata*) and Japanese stiltgrass (*Microstegium vimineum*) which are herbaceous species, and Japanese honeysuckle (*Lonicera japonica*) which can grow either as a shrub or a climbing vine. Two species, Japanese stiltgrass and Japanese knotweed (*Polygonum cuspidatum*) had a high % cover on the plots they invaded.

Table 14. Cover of exotic plants.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	29	2%
<i>Ampelopsis brevipedunculata</i>	Porcelainberry	2	2%
<i>Berberis thunbergii</i>	Japanese barberry	11	7%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	11	7%
<i>Duchesnea indica</i>	Indian strawberry	15	1%
<i>Euonymus fortunei</i>	winter creeper	1	<1%
<i>Glechoma hederacea</i>	ground ivy	7	6%
<i>Hedera helix</i>	English Ivy	7	<1%
<i>Lespedeza cuneata</i>	Chinese lespedeza	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	37	3%
<i>Lonicera</i> spp.	Honeysuckle	2	<1%
<i>Lysimachia nummularia</i>	creeping jenny	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	35	23%
<i>Polygonum caespitosum</i>	Oriental ladythumb	14	<1%
<i>Polygonum cuspidatum</i>	Japanese knotweed	1	18%
<i>Polygonum perfoliatum</i>	mile-a-minute	5	3%
<i>Rosa multiflora</i>	multiflora rose	10	5%
<i>Rubus phoenicolasius</i>	Wineberry	121	2%
<i>Wisteria sinensis</i>	Chinese wisteria	6	<1%

Catoctin Mountain Park

Nine plots were monitored in Catoctin in 2009 (Figure 3).

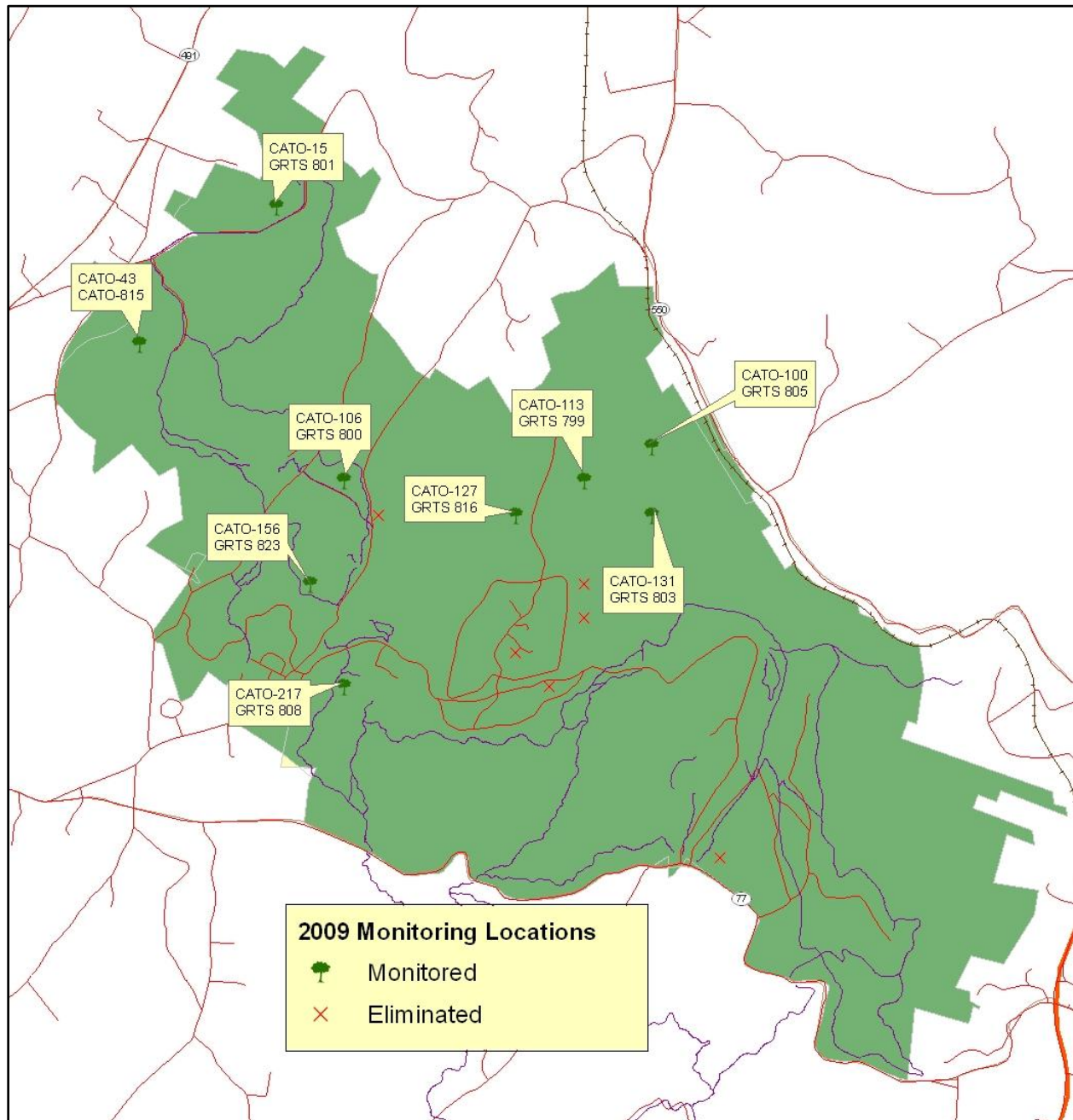


Figure 2. Locations considered for forest monitoring in Catoctin.

Forest Communities

There is considerable variation in tree and sapling density and basal area among plots in Catoctin (Table 15). There were no saplings in the microplots on four of the plots.

Only three seedlings were found in Catoctin, one in each of three plots. Seedling density was less than one-eighteenth that of the region as a whole.

Table 15. Density, basal area (BA) and richness of trees, saplings and seedlings in Catoctin.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings /ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Seedling Species
CATO-0015	17	241	367,000	6	1	118	4160	1	-	-	-
CATO-0043	9	127	251,000	3	1	118	7170	1	1	833	1
CATO-0100	15	212	471,000	7	-	-	-	-	1	833	1
CATO-0106	20	283	482,000	7	4	472	9570	2	1	833	1
CATO-0113	24	340	395,000	11	1	118	6680	1	-	-	-
CATO-0127	36	509	332,000	9	-	-	-	-	-	-	-
CATO-0131	17	241	394,000	7	-	-	-	-	-	-	-
CATO-0156	16	226	228,000	5	-	-	-	-	-	-	-
CATO-0217	26	368	371,000	8	3	354	15,700	2	-	-	-
Total	180	283	366,000	20	10	131	4810	6	3	278	3

In total, 21 tree species were found in Catoctin (Table 16).

Table 16. Tree species found in Catoctin.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	23	14,600	1/1	3	1510	-
<i>Acer saccharum</i>	sugar maple	17	6310	1/1	3	707	-
<i>Betula lenta</i>	sweet birch	9	10,100	-/-	-	-	-
<i>Carpinus caroliniana</i>	American hornbeam	1	123	-/-	1	589	-
<i>Carya cordiformis</i>	bitternut	-	-	-/-	-	-	1
	hickory						
<i>Carya glabra</i>	pignut hickory	4	8210	-/-	-	-	-
<i>Carya ovalis</i>	red hickory	10	5120	-/-	1	458	-
<i>Carya ovata</i>	shagbark	1	693	-/-	-	-	-
	hickory						
<i>Celtis occidentalis</i>	common	-	-	-/-	1	747	-
	hackberry						
<i>Fagus grandifolia</i>	American	4	6140	-/-	-	-	-
	beech						
<i>Fraxinus americana</i>	white ash	19	44,400	5/4	1	799	-
<i>Liriodendron tulipifera</i>	tulip poplar	33	166,800	9/5	-	-	-
<i>Nyssa sylvatica</i>	blackgum	5	2170	-/-	-	-	-
<i>Ostrya virginiana</i>	hop hornbeam	10	1860	1/1	-	-	-
<i>Prunus serotina</i>	black cherry	5	6240	4/4	-	-	-
<i>Quercus prinus</i>	chestnut oak	9	18,200	-/-	-	-	-
<i>Quercus rubra</i>	northern red	10	48,000	1/1	-	-	-
	oak						
<i>Quercus velutina</i>	black oak	2	6640	-/-	-	-	-
<i>Sassafras albidum</i>	sassafras	-	-	-/-	-	-	1
<i>Tilia americana</i>	American	8	5810	1/1	-	-	-
	basswood						
<i>Ulmus rubra</i>	slippery elm	1	2190	-/-	-	-	-

Shrubs were found on only three plots (Table 17). The plots with shrubs are all in the western portion of the park.

Table 17. Density, basal area, seedling density and species richness of shrubs in Catoctin.

Plot	Shrubs	Shrubs per ha	Species	BA (cm ²)/ha	Seedlings	Seedlings/ha
CATO-0015	11	1300	1	294,000	47	39,200
CATO-0043	21	2480	1	481,000	42	35,000
CATO-0100	-	-	-	-	-	-
CATO-0106	-	-	-	-	-	-
CATO-0113	-	-	-	-	-	-
CATO-0127	-	-	-	-	-	-
CATO-0131	-	-	-	-	-	-
CATO-0156	20	2360	1	109,000	1	833
CATO-0217	-	-	-	-	-	-
Total	52	681	1	98,200	90	8330

One species of shrub was found (Table 18).

Table 18. Shrub species found in Catoctin.

Latin Name	Common Name	Shrubs	Seedlings
<i>Lindera benzoin</i>	northern spicebush	52	90

Forest Pests and Diseases

In Catoctin, gypsy moths were found on only 4 trees, which is 2.2% of all trees monitored. By comparison, in 2008, 23.8% of all trees had gypsy moths. The trees infected were all found on plot CATO-0113 in the north central portion of the park. Trees which were impacted include 2 trees of chestnut oak (*Quercus prinus*) and two trees of northern red oak (*Quercus rubra*).

Exotic Plant Species

Exotic Trees

In 2009, no exotic tree species were found on the plots monitored in Catoctin.

Exotic Vines

Only 13.3% of trees had vines on them, compared to 20.2% in the region as a whole. In Catoctin 10.5% of trees had vines in the crown, compared to only 9.1% of trees in the region as a whole.

Table 19. Presence of vines in Catoctin.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
CATO-0015	17	3	3
CATO-0043	9	8	4
CATO-0100	15	1	1
CATO-0106	20	1	-
CATO-0113	24	3	3
CATO-0127	36	1	1
CATO-0131	17	-	-
CATO-0156	16	7	7
CATO-0217	26	-	-
Total	180	24	19

Four native vines were found growing on trees in Catoctin. Summer grape (*Vitis aestivalis*) was the most common, found on 18 trees. No exotic vine species were found on trees in Catoctin in 2009.

Table 20. Species of vines in trees in Catoctin.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
<i>Smilax rotundifolia</i>	roundleaf greenbrier	1	1
<i>Toxicodendron radicans</i>	poison ivy	4	1
<i>Vitis aestivalis</i>	summer grape	18	16
<i>Vitis vulpina</i>	frost grape	2	2

Exotic Shrubs

No exotic species monitored as shrubs were found in Catoctin. However, we did find two exotic species with a shrub like growth that are monitored as herbaceous species (Table 22), Japanese barberry (*Berberis thunbergii*) and wineberry (*Rubus phoenicolasius*).

Exotic Herbaceous Species

All nine plots monitored had exotic herbaceous species (Table 21). In total, 69% of the quadrats had exotic plants in Catoctin, as compared to 58% in the region as a whole.

Table 21. Presence of exotic herbaceous plants in Catoctin.

Plot	Quadrats with Exotics	Number of Exotic Species
CATO-0015	7	3
CATO-0043	12	2
CATO-0100	11	4
CATO-0106	2	2
CATO-0113	10	3
CATO-0127	10	3
CATO-0131	7	2
CATO-0156	12	6
CATO-0217	3	1
Total		7

Seven exotic species were found on the plots. Japanese barberry (*Berberis thunbergii*) and Japanese stiltgrass (*Microstegium vimineum*) were the most common (Table 22).

Table 22. Cover of exotic herbaceous plants in Catoctin.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	5	<1%
<i>Berberis thunbergii</i>	Japanese barberry	5	10%
<i>Glechoma hederacea</i>	ground ivy	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	8	30%
<i>Polygonum caespitosum</i>	Oriental ladythumb	4	1%
<i>Polygonum perfoliatum</i>	mile-a-minute	1	<1%
<i>Rubus phoenicolasius</i>	Wineberry	2	<1%

Chesapeake and Ohio Canal National Historical Park

Seventeen plots were monitored along the C&O Canal in 2009. The plots were located along the length of the canal (Figure 3).

Forest Communities

There is considerable variation in all measures relating to trees across the plots (Table 31).

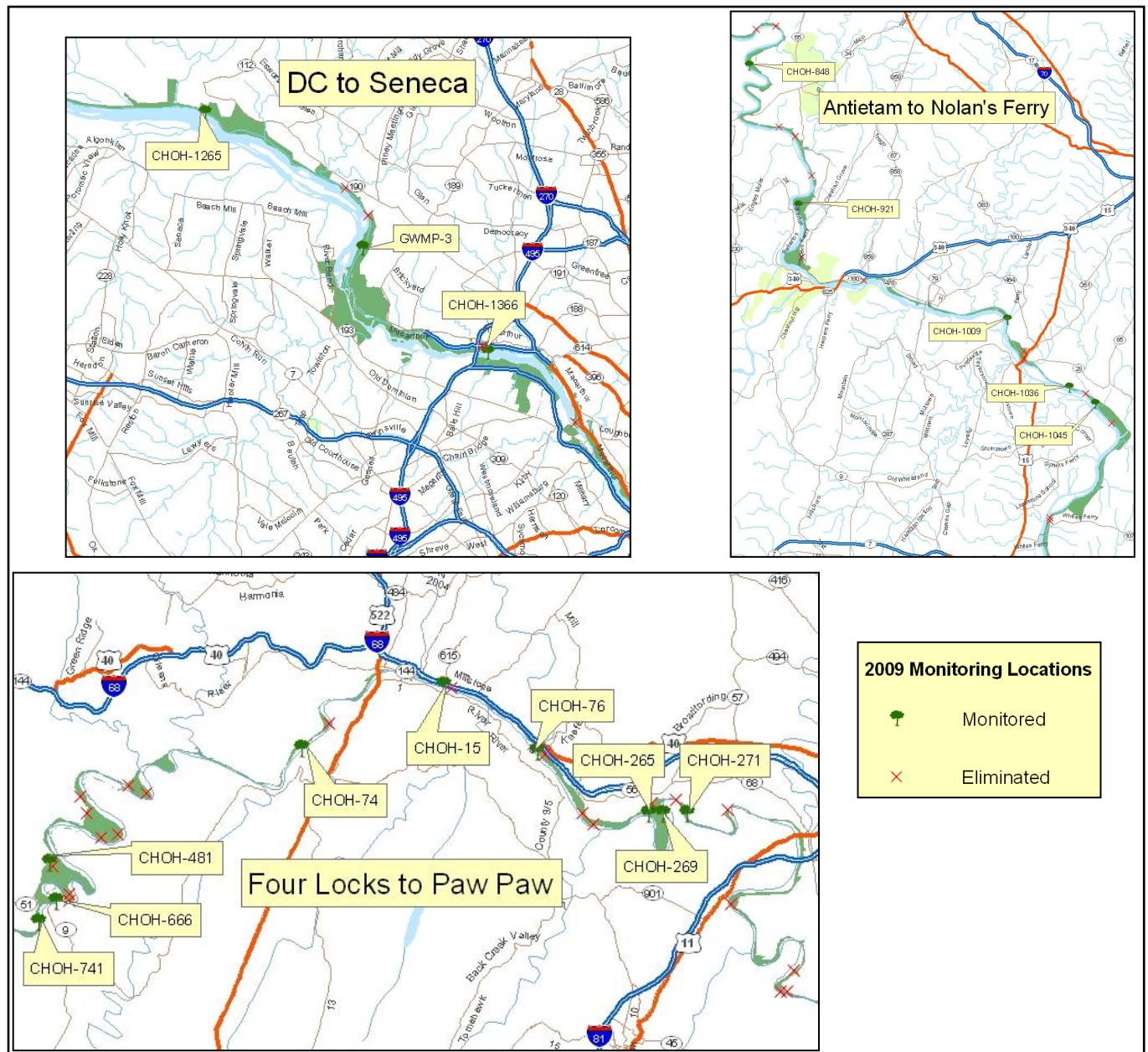


Figure 3. Locations considered for forest monitoring along the C&O Canal.

Table 23. Density, basal area (BA) and richness of trees, saplings and seedlings on the C&O Canal.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ ha	Species
CHOH-0015	54	764	232,000	4	1	118	8180	1	6	5000	1
CHOH-0069	21	297	204,000	6	9	1060	10,100	1	7	5830	2
CHOH-0075	10	141	90,100	2	-	-	-	-	1	833	1
CHOH-0265	43	608	239,900	7	2	236	14,300	2	1	833	1
CHOH-0269	21	297	313,000	10	-	-	-	-	29	24,200	6
CHOH-0271	23	325	120,000	8	2	236	1980	1	10	8330	2
CHOH-0488	27	382	144,000	7	8	943	25,900	5	2	1670	2
CHOH-0684	10	141	60,100	5	18	2120	47,300	2	4	3330	2
CHOH-0741	36	509	327,000	8	7	825	18,900	3	-	-	-
CHOH-0847	19	269	306,000	11	31	3660	16,000	2	19	15,800	4
CHOH-0921	21	297	82,400	6	2	236	5260	1	1	833	1
CHOH-1009	25	354	793,000	5	7	825	20,500	2	12	10,000	4
CHOH-1036	25	354	147,000	3	10	1180	27,600	1	19	15,800	4
CHOH-1044	34	481	324,000	4	10	1180	46,700	2	13	10,800	2
CHOH-1265	19	269	181,000	5	17	2000	18,700	1	9	7500	2
CHOH-1366	19	269	374,000	11	24	2830	29,300	2	9	7500	4
GWMP-0003	33	467	386,000	8	5	589	11,400	3	1	833	1
Total	440	366	254,000	35	153	1060	16,600	116	143	7010	16

Thirty-eight different tree species were found along the C&O Canal (Table 24).

Table 24. Tree species found along the C&O Canal.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	133	36,700	51/27	15	3050	56
<i>Acer rubrum</i>	red maple	5	1990	1/-	-	-	1
<i>Acer saccharinum</i>	silver maple	36	44,700	19/9	-	-	2
<i>Acer saccharum</i>	sugar maple	1	1080	-	-	-	-
¹ <i>Ailanthus altissima</i>	tree of heaven	8	1570	7/6	2	305	-
<i>Amelanchier arborea</i>	common serviceberry	-	-	-	2	173	1
<i>Asimina triloba</i>	pawpaw	25	2740	16/9	115	9070	46
<i>Carya alba</i>	mockernut	3	787	-	1	368	-
<i>Carya</i>	hickory						
<i>Carya</i>	bitternut	10	9650	3/1	-	-	6
<i>cordiformis</i>	hickory						
<i>Carya glabra</i>	pignut hickory	8	6520	1/1	2	388	1
<i>Celtis</i>	common	3	1060	1/1	1	215	4
<i>occidentalis</i>	hackberry						
<i>Cercis canadensis</i>	eastern redbud	-	-	-	1	236	-
<i>Cornus florida</i>	flowering dogwood	1	155	-	-	-	-
<i>Crataegus crus-</i>	cockspur	-	-	-	2	333	-
<i>galli</i>	hawthorn						
<i>Fagus grandifolia</i>	American beech	4	2280	2/-	-	-	-
<i>Fraxinus</i>	white ash	16	13,600	11/3	2	118	14
<i>americana</i>							
<i>Fraxinus</i>	green ash	1	565	-	-	-	2
<i>pennsylvanica</i>							
<i>Gleditsia</i>	honey locust	2	955	2/2	-	-	1
<i>triacanthos</i>							
<i>Juglans nigra</i>	black walnut	13	6180	7/7	-	-	1
<i>Juniperus</i>	eastern red	6	1740	3/3	-	-	-
<i>virginiana</i>	cedar						
<i>Liriodendron</i>	tulip poplar	46	41,100	28/14	-	-	-
<i>tulipifera</i>							
¹ <i>Morus alba</i>	white mulberry	3	1180	3/3	-	-	-
<i>Ostrya virginiana</i>	hop hornbeam	-	-	-	1	208	-
<i>Pinus strobus</i>	white pine	2	4780	-	-	-	-
<i>Pinus virginiana</i>	Virginia pine	5	2400	-	-	-	-
<i>Platanus</i>	American	5	10,700	4/1	1	409	-
<i>occidentalis</i>	sycamore						
<i>Populus deltoides</i>	eastern cottonwood	5	25,100	5/-	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	1	733	1/1	-	-	1

Table 24. Tree species found along the C&O Canal (continued).

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Prunus serotina</i>	black cherry	21	4640	15/13	2	680	2
<i>Quercus alba</i>	white oak	5	5350	1/1	-	-	1
<i>Quercus muehlenbergii</i>	chinkapin oak	3	2460	1/-	-	-	-
<i>Quercus prinus</i>	chestnut oak	8	2580	-	2	381	-
<i>Quercus rubra</i>	northern red oak	5	2620	-	1	347	-
<i>Quercus stellata</i>	post oak	4	882	1/1	-	-	-
<i>Robinia pseudoacacia</i>	black locust	29	7370	24/17	-	-	-
<i>Sassafras albidum</i>	sassafras	1	94	1/1	-	-	4
<i>Tilia americana</i>	American basswood	1	3820	1/-	-	-	-
<i>Ulmus americana</i>	American elm	19	5700	8/5	3	277	1

¹Non-native species.

Shrubs were found along the canal (Table 25).

Table 25. Density, basal area, seedling density and richness of shrubs along the C&O Canal.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedling/ha
CHOH-0015	4	472	2	65,900	32	26,700
CHOH-0069	4	472	1	36,200	16	13,300
CHOH-0075	-	-	-	-	-	-
CHOH-0265	-	-	-	-	1	833
CHOH-0269	1	118	1	49,800	4	3330
CHOH-0271	3	354	1	4670	2	1670
CHOH-0488	-	-	-	-	-	-
CHOH-0684	-	-	-	-	-	-
CHOH-0741	1	118	1	6070	1	833
CHOH-0847	2	236	1	7680	5	4170
CHOH-0921	-	-	-	-	-	-
CHOH-1009	8	943	1	103,000	9	7500
CHOH-1036	5	589	1	74,500	5	4170
CHOH-1044	1	118	1	42,400	10	8330
CHOH-1265	1	118	1	33,100	-	-
CHOH-1366	-	-	-	-	4	3330
GWMP-0003	1	118	1	13,300	-	-
Total	31	215	3	25,700	89	4362

Five shrub species were found along the canal. Northern spicebush (*Lindera benzoin*) was the most common shrub (Table 26).

Table 26. Shrub species found along the C&O Canal.

Latin Name	Common Name	Shrubs	Seedlings
¹ <i>Elaeagnus umbellata</i>	autumn olive	1	3
¹ <i>Euonymus alatus</i>	burning bush	-	1
¹ <i>Ligustrum vulgare</i>	European privet	3	2
<i>Lindera benzoin</i>	northern spicebush	27	82
¹ <i>Symphoricarpos orbiculatus</i>	coralberry	-	1

¹Non-native species.

Forest Pests and Diseases

Dogwood anthracnose was found on one tree on plot CHOH-0847, directly west of Antietam National Battlefield. No other targeted pests or diseases were found.

Exotic Plant Species

Exotic Trees

Three exotic tree species are found along the canal (Table 24). They make up 2.7% of all individuals and 1.4% of all basal area in the tree layer, 1.3% of all individuals and 1.8% of all basal area in the sapling layer, and are 0.7% of all seedlings.

Vines in Trees

Vines in trees are common along the C&O Canal (Table 27).

Table 27. Presence of vines along the C&O Canal.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
CHOH-0015	54	12	1
CHOH-0069	21	17	14
CHOH-0075	10	-	-
CHOH-0265	43	27	22
CHOH-0269	21	9	4
CHOH-0271	23	21	18
CHOH-0488	27	2	2
CHOH-0684	10	8	4
CHOH-0741	36	23	16
CHOH-0847	19	2	-
CHOH-0921	21	20	14
CHOH-1009	25	16	1
CHOH-1036	25	19	13
CHOH-1044	34	11	7
CHOH-1265	19	3	-
CHOH-1366	19	6	1
GWMP-0003	33	22	9
Total	440	218	126

Most vines growing in trees along the Canal are native species (Table 28). However, numerous exotic vines, from six exotic species were also found. Japanese honeysuckle (*Lonicera japonica*) was the most common exotic vine.

Table 28. Species of vines in trees along the C&O Canal.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
<i>Campsis radicans</i>	trumpet creeper	2	1
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	5	5
¹ <i>Hedera helix</i>	English ivy	14	-
¹ <i>Humulus japonicus</i>	Japanese hop	2	-
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	35	22
<i>Menispermum canadense</i>	common moonseed	2	1
<i>Parthenocissus quinquefolia</i>	Virginia creeper	100	49
¹ <i>Polygonum perfoliatum</i>	mile-a-minute	1	-
¹ <i>Rosa multiflora</i>	multiflora rose	10	4
<i>Sicyos angulatus</i>	oneseed burr cucumber	1	1
<i>Toxicodendron radicans</i>	poison ivy	16	4
<i>Vitis aestivalis</i>	summer grape	6	5
<i>Vitis riparia</i>	riverbank grape	1	1
<i>Vitis vulpina</i>	frost grape	103	88
<i>Vitis</i> spp.	grape	1	1

¹ Non-native species.

Exotic Shrubs

Of the five shrub species found (Table 26), four are exotic. In total, four exotic shrubs and seven exotic shrub seedlings were found. Together these represent 12.9% of all individual shrubs, and 7.9% of all shrub seedlings.

Exotic Herbaceous Plants

Exotic herbaceous plants are very common along the C&O Canal. All but one plot, and 89% of all quadrats monitored, had exotic plants growing on them (Table 29).

Table 29. Presence of exotic herbaceous plants along the C&O Canal.

Plot	Quadrats with Exotics	Number of Exotic Species
CHOH-0015	12	4
CHOH-0069	8	7
CHOH-0075	10	3
CHOH-0265	12	7
CHOH-0269	12	6
CHOH-0271	12	9
CHOH-0488	-	-
CHOH-0684	12	7
CHOH-0741	12	6
CHOH-0847	12	5
CHOH-0921	12	6
CHOH-1009	12	6
CHOH-1036	11	3
CHOH-1044	10	4
CHOH-1265	12	6
CHOH-1366	12	6
GWMP-0003	12	4
Total		17

Seventeen species of exotic herbaceous plants were found along the canal (Table 30).

Table 30. Cover of exotic herbaceous plants along the C&O Canal.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	15	2%
<i>Berberis thunbergii</i>	Japanese barberry	2	7%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	2	7%
<i>Duchesnea indica</i>	Indian strawberry	11	1%
<i>Euonymus fortunei</i>	winter creeper	1	<1%
<i>Glechoma hederacea</i>	ground ivy	5	4%
<i>Hedera helix</i>	English ivy	1	4%
<i>Lespedeza cuneata</i>	Chinese lespedeza	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	13	3%
<i>Lonicera</i> spp.	honeysuckle	1	<1%
<i>Lysimachia nummularia</i>	creeping jenny	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	14	31%
<i>Polygonum caespitosum</i>	Oriental ladythumb	8	<1%
<i>Polygonum cuspidatum</i>	Japanese knotweed	1	18%
<i>Polygonum perfoliatum</i>	mile-a-minute	2	6%
<i>Rosa multiflora</i>	multiflora rose	7	6%
<i>Rubus phoenicolasius</i>	wineberry	4	4%

George Washington Memorial Parkway

Three plots were monitored along the George Washington Memorial Parkway (GWMP) in 2009.

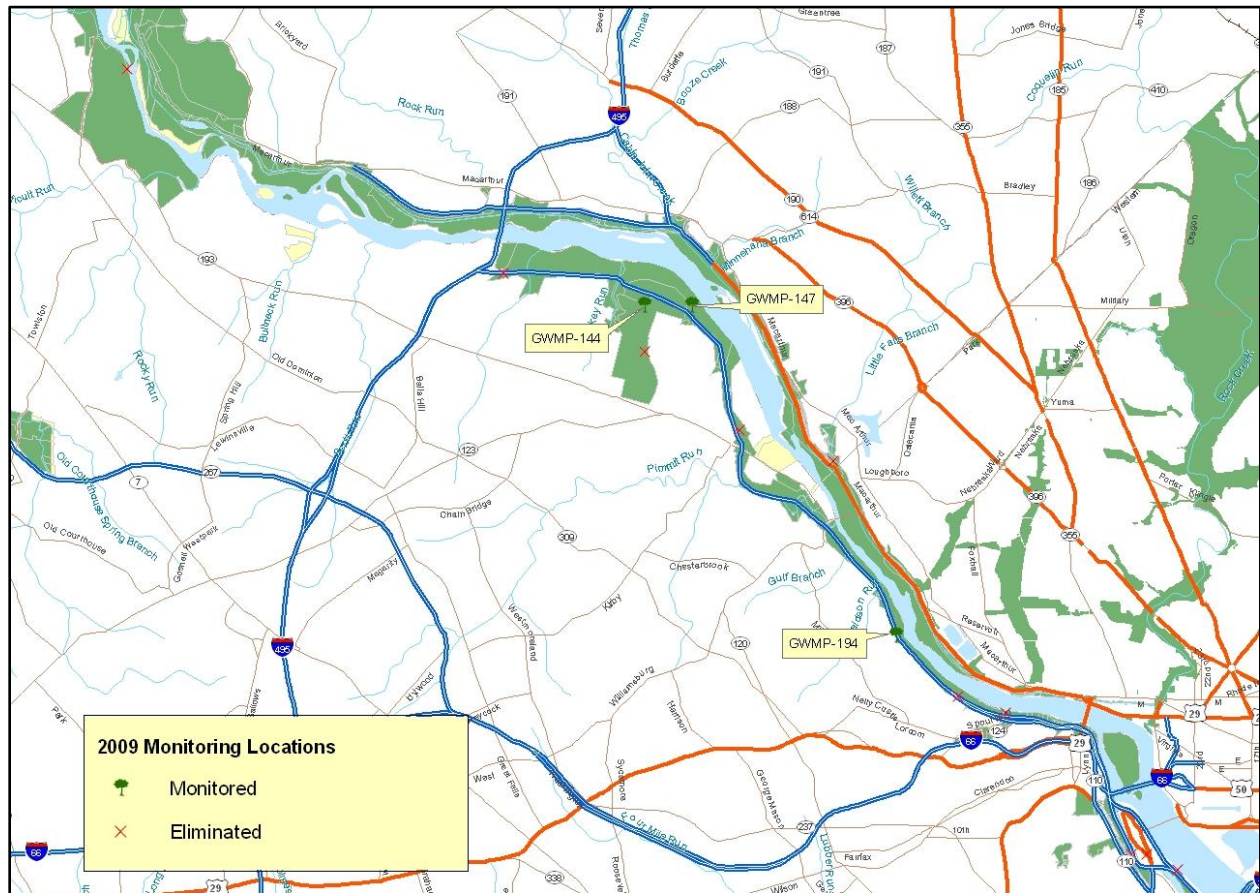


Figure 4. Locations considered for forest monitoring in George Washington Memorial Parkway.

Forest Communities

Density and basal area information for the three plots is presented in Table 31. In total, nineteen tree species were found (Table 32).

Table 31. Density, basal area (BA) and richness of trees, saplings and seedlings in GWMP.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
GWMP-0144	16	226	431,000	1	7	825	13,200	3	3	2500	2
GWMP-0147	15	212	278,000	8	18	2120	26,300	5	14	11,700	2
GWMP-0194	17	241	127,000	10	2	236	4,820	2	2	1670	2
Total	48	226	278,000	13	27	1060	14,800	8	19	5280	6

Table 32. Tree species found in GWMP.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	6	5820	-	-	-	-
<i>Asimina triloba</i>	pawpaw	-	-	-	10	786	12
<i>Carpinus carolina</i>	American hornbeam	-	-	-	1	550	-
<i>Carya alba</i>	mockernut	1	2780	1/-	-	-	-
	hickory						
<i>Carya ovalis</i>	red hickory	1	10,500	-	-	-	-
<i>Cornus florida</i>	flowering dogwood	-	-	-	3	2712	-
<i>Fagus grandifolia</i>	American beech	8	28,600	-	8	5820	1
<i>Fraxinus americana</i>	white ash	2	962	1/1	1	1730	2
<i>Ilex opaca</i>	American holly	1	971	-	-	-	1
<i>Liriodendron tulipifera</i>	tulip poplar	21	171,000	5/-	1	1450	1
¹ <i>Malus</i> spp.	apple	-	-	-	1	1260	-
<i>Nyssa sylvatica</i>	blackgum	1	3450	-	-	-	-
<i>Ostrya virginiana</i>	hop hornbeam	-	-	-	1	1260	-
<i>Platanus occidentalis</i>	American sycamore	1	5380	-	-	-	-
<i>Prunus serotina</i>	black cherry	1	1820	-	-	-	2
<i>Quercus alba</i>	white oak	2	20,800	-	-	-	-
<i>Quercus rubra</i>	northern red oak	2	24,600	1/-	-	-	-
<i>Tilia americana</i>	American basswood	1	2130	-	-	-	-
<i>Ulmus americana</i>	American elm	-	-	-	2	354	-

Shrubs were found in all three of the GWMP plots monitored in 2009 (Table 33).

Table 33. Density, basal area, seedling density and richness of shrubs in GWMP.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
GWMP-0144	2	236	2	1260	15	12,500
GWMP-0147	2	236	1	4690	-	-
GWMP-0194	16	1890	1	88,500	7	5830
Total	20	786	2	31,500	22	6110

Three shrub species were found (Table 34), the most common of which was northern spicebush (*Lindera benzoin*)

Table 34. Shrub species found in GWMP.

Latin Name	Common Name	Shrubs	Seedlings
¹ <i>Elaeagnus umbellata</i>	autumn olive	1	-
¹ <i>Euonymus alatus</i>	burning bush	-	1
<i>Lindera benzoin</i>	northern spicebush	19	21

¹Non-native species.

Forest Pests and Diseases.

No forest pest or diseases were found on the plots in 2009.

Exotic Plant Species

Exotic Trees

The only exotic tree encountered was a single *Malus* spp. sapling. It represents 3.7% of all sapling individuals and 8.5% of all sapling basal area.

Vines in Trees

Vines were found in trees in all three plots, but rarely in the tree crown (Table 35).

Table 35. Presence of vines in GWMP.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
GWMP-0144	16	5	-
GWMP-0147	15	1	-
GWMP-0194	17	2	1
Total	48	8	1

All of the vines found on trees were poison ivy (*Toxicodendron radicans*) the (Table 36).

Table 36. Species of vines in trees in GWMP.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
<i>Toxicodendron radicans</i>	eastern poison ivy	8	1

Exotic Shrubs

Of the three shrub species found (Table 34), two are exotic. None of the exotic shrubs were particularly abundant. In total, one exotic shrub and one exotic shrub seedling were found. These represent 5.0% of all individual shrubs, and 4.5% of all shrub seedlings.

Exotic Herbaceous Species

Exotic herbaceous plants were found on all three plots (Table 37).

Table 37. Presence of exotic herbaceous plants in GWMP.

Plot	Quadrats with Exotics	Number of Exotic Species
GWMP-0144	9	7
GWMP-0147	2	2
GWMP-0194	4	2
Total		9

Although there were numerous exotic herbaceous species present, none of them had a mean cover greater than 1% (Table 38).

Table 38. Cover of exotic herbaceous plants in GWMP.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	2	<1%
<i>Berberis thunbergii</i>	Japanese barberry	1	1%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	1	1%
<i>Hedera helix</i>	English ivy	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	2	<1%
<i>Lonicera</i> spp.	honeysuckle	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	1	<1%
<i>Rubus phoenicolasius</i>	wineberry	1	<1%
<i>Viburnum dilatatum</i>	linden arrowwood	1	1%

Harpers Ferry National Historical Park

Five plots were monitored in Harper's Ferry in 2009 (Figure 5).



Figure 5. Locations considered for forest monitoring in Harpers Ferry.

Forest Communities

Density and basal area information for the five plots is presented in Table 39. In total, 24 tree species were found in the plots (Table 40).

Table 39. Density, basal area (BA) and richness of trees, saplings and seedlings in Harpers Ferry.

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
HAFE-0005	13	184	220,000	6	3	354	6270	2	8	6670	1
HAFE-0047	25	354	292,000	9	9	1060	29,000	5	-	-	-
HAFE-0161	20	283	346,000	9	2	236	6860	1	8	6670	3
HAFE-0211	33	467	271,000	8	13	1530	35,000	5	1	833	1
HAFE-0240	36	509	378,000	8	4	472	10,800	3	3	2500	1
Total	127	359	301,000	21	31	731	17,600	12	20	3330	4

Table 40. Tree species found in Harpers Ferry.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	18	12,800	7/5	3	566	-
<i>Acer saccharum</i>	sugar maple	3	5060	1/1	2	1370	-
¹ <i>Ailanthus altissima</i>	tree of heaven	2	976	1/-	-	-	-
<i>Asimina triloba</i>	pawpaw	-	-	-	2	141	17
<i>Betula lenta</i>	sweet birch	2	12,400	-/-	-	-	-
<i>Carya alba</i>	mockernut	4	2060	1/1	4	2880	-
	hickory						
<i>Carya cordiformis</i>	bitternut	2	1690	1/1	-	-	-
	hickory						
<i>Carya glabra</i>	pignut hickory	5	2200	2/2	2	1230	-
<i>Celtis occidentalis</i>	common	4	1920	-	4	1600	-
	hackberry						
<i>Cercis canadensis</i>	eastern redbud	1	481	-	2	1080	-
<i>Fagus grandifolia</i>	American	2	4580	-	-	-	-
	beech						
<i>Fraxinus americana</i>	white ash	8	10,900	2/1	1	872	1
<i>Juniperus virginiana</i>	eastern red	1	320	-	-	-	-
	cedar						
<i>Liriodendron tulipifera</i>	tulip poplar	9	66,900	5/4	-	-	-
<i>Nyssa sylvatica</i>	blackgum	13	5880	3/-	6	3610	-
¹ <i>Paulownia tomentosa</i>	princess tree	1	5850	1/1	-	-	-
<i>Prunus serotina</i>	black cherry	1	2430	1/-	1	472	-
<i>Quercus prinus</i>	chestnut oak	30	92,200	16/6	-	-	1
<i>Quercus rubra</i>	northern red	13	37,200	2/1	-	-	-
	oak						
<i>Quercus velutina</i>	black oak	4	14,000	2/1	-	-	2
<i>Robinia pseudoacacia</i>	black locust	-	-	-	-	-	1
<i>Sassafras albidum</i>	sassafras	3	17,100	-	-	-	-
<i>Ulmus americana</i>	American elm	-	-	-	2	2500	-
<i>Ulmus rubra</i>	slippery elm	1	4340	-	2	1250	-

¹Non-native species.

Shrubs were found in three of the plots (Table 41).

Table 41. Density, basal area, seedling density and richness of shrubs in Harper's Ferry.

Plot	Shrubs	Shrubs / ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
HAFE-0005	4	472	1	8550	-	-
HAFE-0047	-	-	-	-	-	-
HAFE-0161	4	472	1	17,500	6	5000
HAFE-0211	-	-	-	-	-	-
HAFE-0240	9	1060	3	381,000	4	3330
Total	17	401	3	81,500	10	1670

Three shrub species were found (Table 42).

Table 42. Shrub species found in Harpers Ferry.

Latin Name	Common Name	Shrubs	Seedlings
<i>Hamamelis virginiana</i>	American witchhazel	4	-
<i>Lindera benzoin</i>	northern spicebush	12	10
<i>Viburnum prunifolium</i>	blackhaw	1	-

Forest Pests and Diseases

In Harpers Ferry, gypsy moths were found on 10 trees, which is 7.8% of all trees monitored. In comparison, in 2008, gypsy moth was found on 7.4% of all trees monitored. The gypsy moths were found on plots HAFE-0211 (9 trees) and HAFE-0240 (1 tree) which are located near the Appalachian trail in the Werner Tract section in the south of the park. In 2008 gypsy moth was found throughout the park. The only tree species impacted was chestnut oak (*Quercus prinus*).

Exotic Plant Species

Exotic Trees

Two exotic tree species were found (Table 40). They make up 2.4% of all individuals and 2.3% of all basal area in the tree layer, and are absent from the sapling and seedling layers.

Vines on Trees

Many vines were found on trees in 2009, and almost one fifth of all trees had vines in their crowns (Table 43).

Table 43. Presence of vines in Harpers Ferry.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
HAFE-0005	13	7	5
HAFE-0047	25	2	-
HAFE-0161	20	4	4
HAFE-0211	33	12	10
HAFE-0240	36	21	6
Total	127	46	25

All but one vine monitored in Harpers Ferry was native (Table 44).

Table 44. Species of vines in trees in Harpers Ferry.

Latin Name	Common Name	Trees with Vines	Tree with Vines in Crown
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	1	-
<i>Parthenocissus quinquefolia</i>	Virginia creeper	15	5
<i>Smilax rotundifolia</i>	greenbrier	2	-
<i>Toxicodendron radicans</i>	poison ivy	11	5
<i>Vitis aestivalis</i>	summer grape	15	13
<i>Vitis vulpina</i>	frost grape	1	-
<i>Vitis</i> spp.	grape	9	8

¹Non-native species.

Exotic Shrubs

All shrubs found in the monitoring plots were native (Table 42).

Exotic Herbaceous Plants

Exotic herbaceous species were found on four of the five plots in Harpers Ferry (Table 45).

Table 45. Presence of exotic herbaceous plants in Harpers Ferry.

Plot	Quadrats with Exotics	Number of Exotic Species
HAFE-0005	11	2
HAFE-0047	1	1
HAFE-0161	9	2
HAFE-0211	1	1
HAFE-0240	-	-
Total		4

Four species of exotic herbaceous species were found in the plots (Table 46). Garlic mustard (*Alliaria petiolata*) was the most widespread.

Table 46. Cover of exotic herbaceous plants in Harpers Ferry.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	3	1%
<i>Berberis thunbergii</i>	Japanese barberry	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	1	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	1	<1%

Manassas National Battlefield Park

Two forest vegetation plots were monitored in Manassas in 2009 (Figure 6).

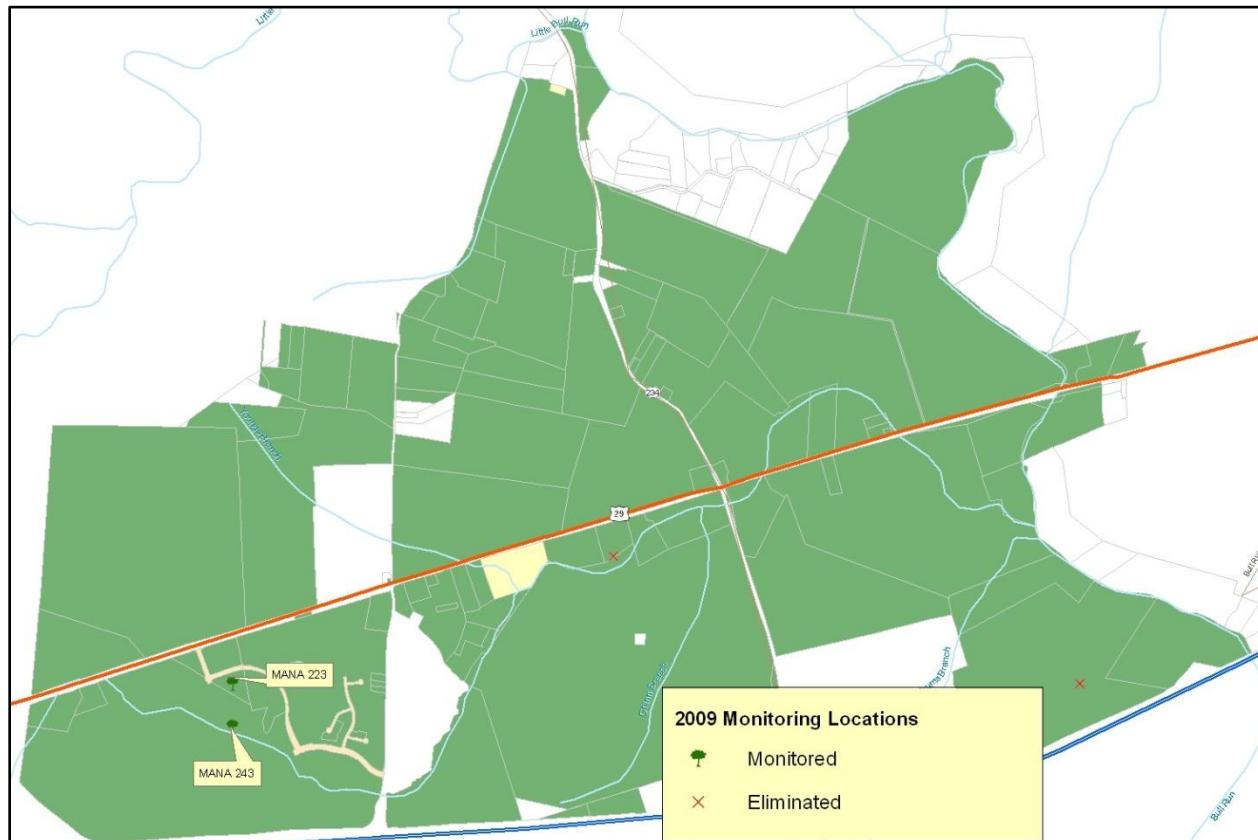


Figure 6. Locations considered for forest monitoring in Manassas.

Forest Communities

Tree density and basal area is presented in Table 47. Twelve tree species were found on the plots (Table 48). No seedlings were found on either plot.

Table 47. Density, basal area (BA) and richness of trees, saplings and seedlings in Manassas.

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
MANA-0223	31	439	226,000	6	4	472	13,200	4	-	-	-
MANA-0243	32	453	211,000	8	8	943	22,000	6	-	-	-
Total	63	446	218,000	10	12	707	17,600	9	-	-	-

Table 48. Tree species found in Manassas.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in canopy	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Carpinus caroliniana</i>	American hornbeam	-	-	-	2	1710	-
<i>Carya glabra</i>	pignut hickory	20	43,100	-	1	236	-
<i>Cornus florida</i>	flowering dogwood	-	-	-	1	354	-
<i>Fraxinus americana</i>	white ash	4	12,900	1/1	3	7130	-
<i>Juniperus virginiana</i>	eastern red cedar	2	3370	-	-	-	-
<i>Pinus virginiana</i>	Virginia pine	3	13,900	-	-	-	-
<i>Quercus alba</i>	white oak	14	46,200	-	1	354	-
<i>Quercus falcata</i>	southern red oak	4	6800	-	-	-	-
<i>Quercus rubra</i>	northern red oak	6	12,400	-	1	3770	-
<i>Quercus shumardii</i>	Shumard's oak	2	33,600	1/-	1	3240	-
<i>Quercus stellata</i>	post oak	6	43,200	-	1	236	-
<i>Ulmus americana</i>	American elm	2	2700	-	1	589	-

Shrub seedlings were found in one of the Manassas plots (Table 49).

Table 49. Density, basal area, seedling density and richness of shrubs in Manassas.

Plot	Shrubs	Shrubs/ ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
MANA-0223	-	-	-	-	-	-
MANA-0243	-	-	-	-	3	2500
Total	-	-	-	-	3	1250

One shrub species was encountered (Table 50).

Table 50. Shrub species found in Manassas.

Latin Name	Common Name	Shrubs	Seedlings
<i>Viburnum prunifolium</i>	blackhaw	-	3

Forest Pest and Diseases

No targeted forest pests or diseases were found on the plots in Manassas in 2009.

Exotic Plant Species

Exotic Trees

No exotic trees were monitored in Manassas in 2009.

Vines on Trees

Vines were found on only 2 trees in Manassas and were in the crown of only 1 tree (Table 51).

Table 51. Presence of vines in Manassas.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
MANA-0223	31	-	-
MANA-0243	32	2	1
Total	63	2	1

Only two vine species were encountered in Manassas (Table 52).

Table 52. Species of vines in trees in Manassas.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
<i>Parthenocissus quinquefolia</i>	Virginia creeper	1	1
<i>Toxicodendron radicans</i>	poison ivy	1	-

Exotic Shrubs

No exotic shrub species were found on the monitoring plots in Manassas in 2009 (Table 50).

Exotic Herbaceous Plants

Exotics were found in both plots in Manassas (Table 53).

Table 53. Frequency of exotic herbaceous plants in Manassas.

Plot	Quadrats with exotics	Number of exotic species
MANA-0223	1	1
MANA-0243	8	2
Total		2

Two herbaceous exotic species were found on the plots (Table 54).

Table 54. Cover of herbaceous exotic plants in Manassas.

Latin name	Common name	Plots	Mean % cover when present
<i>Lonicera japonica</i>	Japanese honeysuckle	2	1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	1	<1%

Monocacy National Battlefield

One forest vegetation plot was monitored in Monocacy in 2009 (Figure 7).

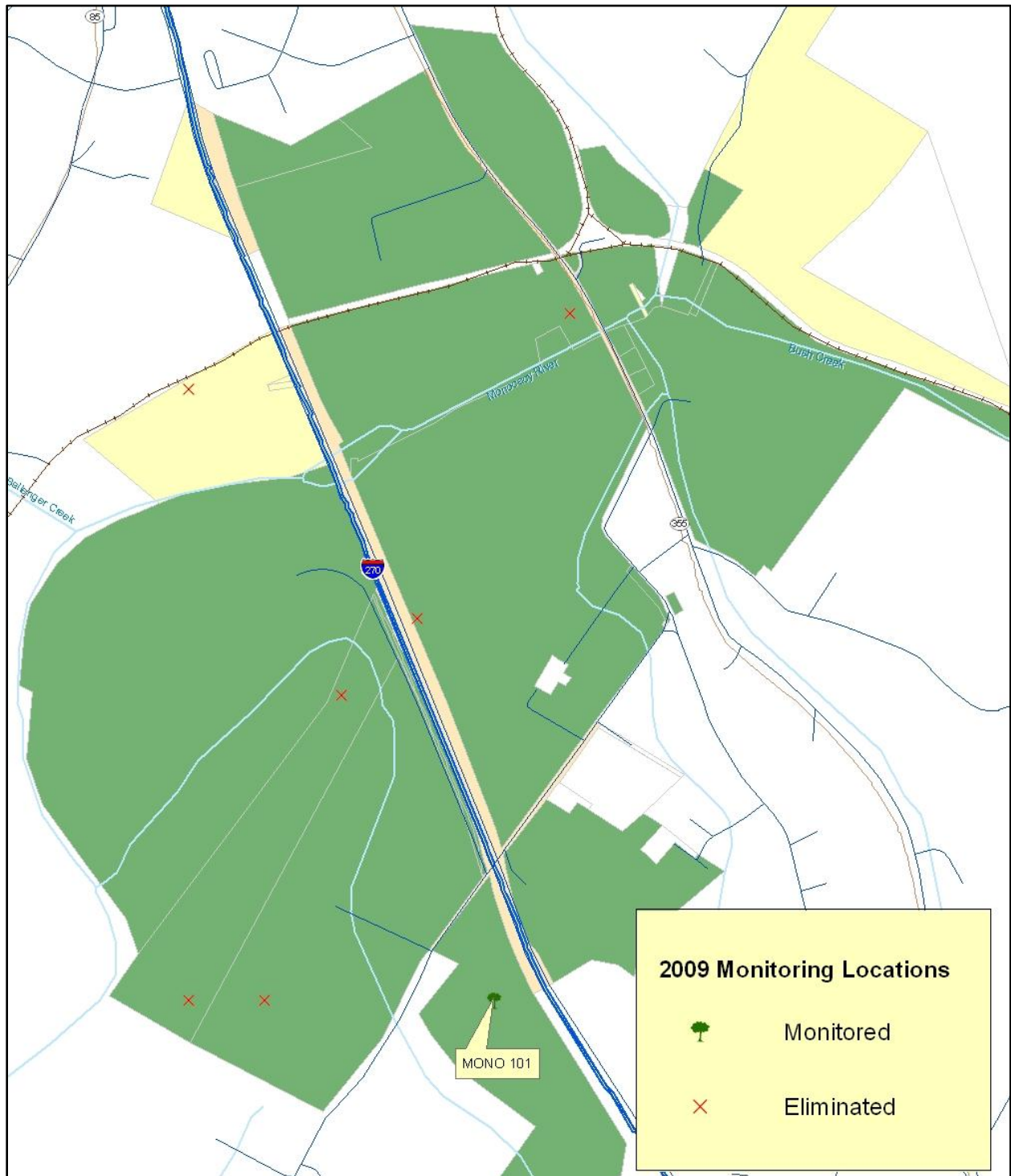


Figure 7. Locations considered for forest monitoring in Monocacy.

Forest Communities

The tree density on the single Monocacy plot is lower than the regional average (Table 55). Ten different tree species were found on the plot (Table 56).

Table 55. Density, basal area (BA) and richness of trees, saplings and seedlings in Monocacy.

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
MONO-0101	24	340	213,000	9	4	472	16,200	3	12	10,000	1

Table 56. Tree species found in Monocacy.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in canopy	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	6	25,600	3/2	1	2360	12
¹ <i>Ailanthus altissima</i>	tree of heaven	-	-	-	1	4230	-
<i>Celtis occidentalis</i>	common hackberry	1	1770	-	-	-	1
<i>Diospyros virginiana</i>	common persimmon	2	9660	2/2	-	-	-
<i>Fraxinus americana</i>	white ash	1	2890	1/1	-	-	-
<i>Juglans nigra</i>	black walnut	2	4940	1/1	2	9780	-
¹ <i>Morus alba</i>	white mulberry	2	27,400	2/1	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	1	15,100	1/1	-	-	-
<i>Prunus serotina</i>	black cherry	4	20,800	1/1	-	-	-
<i>Robinia pseudoacacia</i>	black locust	5	105,000	4/4	-	-	-

¹Non-native species.

No shrubs were found on the Monocacy plot.

Forest Pest and Diseases

No target forest pests or diseases were found on the Monocacy plot in 2009.

Exotic Plant Species

Exotic Trees

Three exotic tree species were found on the Monocacy plot (Table 56). These species represent 12.5% of all individuals and 20.0% of all basal area in the tree layer, 25.0% of all individuals and 26.1% of all basal area in the sapling layer and are absent in the seedling layer.

Vines on Trees

Vines were found on only 15 trees in Manassas and were in the crown of 13 trees (Table 57).

Table 57. Presence of vines in Monocacy.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
MONO-0101	24	15	13

Six vine species were encountered in Monocacy (Table 58).

Table 58. Species of vines in trees in Monocacy.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	1	1
<i>Parthenocissus quinquefolia</i>	Virginia creeper	3	3
¹ <i>Polygonum perfoliatum</i>	mile-a-minute	2	2
<i>Smilax rotundifolia</i>	roundleaf greenbrier	2	2
<i>Toxicodendron radicans</i>	poison ivy	2	1
<i>Vitis vulpina</i>	frost grape	11	10

Exotic Shrubs

No exotic shrubs were found on the Monocacy plot.

Exotic Herbaceous Plants

Exotic herbaceous species were found in nearly all of the quadrats on the Monocacy Plot (Table 59).

Table 59. Frequency of exotic herbaceous plants in Monocacy.

Plot	Quadrats with exotics	Number of exotic species
MONO-0106	11	8

Of the eight herbaceous exotic species found, Japanese stiltgrass (*Microstegium vimineum*) had the highest percent cover (Table 60).

Table 60. Cover of exotic herbaceous plants in Monocacy.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	1	6%
<i>Duchesnea indica</i>	Indian strawberry	1	5%
<i>Lonicera japonica</i>	Japanese honeysuckle	1	5%
<i>Microstegium vimineum</i>	Japanese stiltgrass	1	12%
<i>Polygonum caespitosum</i>	Oriental ladythumb	1	3%
<i>Polygonum perfoliatum</i>	mile-a-minute	1	<1%
<i>Rosa multiflora</i>	multiflora rose	1	3%
<i>Rubus phoenicolasius</i>	wineberry	1	2%

National Capital Parks East

Twelve plots were monitored in NACE in 2009 (Figure 8). These included four plots in Piscataway, one plot in Greenbelt, three plots along the Baltimore-Washington Parkway and one each in the Fort Circle Trail, Fort Dupont, Anacostia Park and near Oxon Hill Farm.

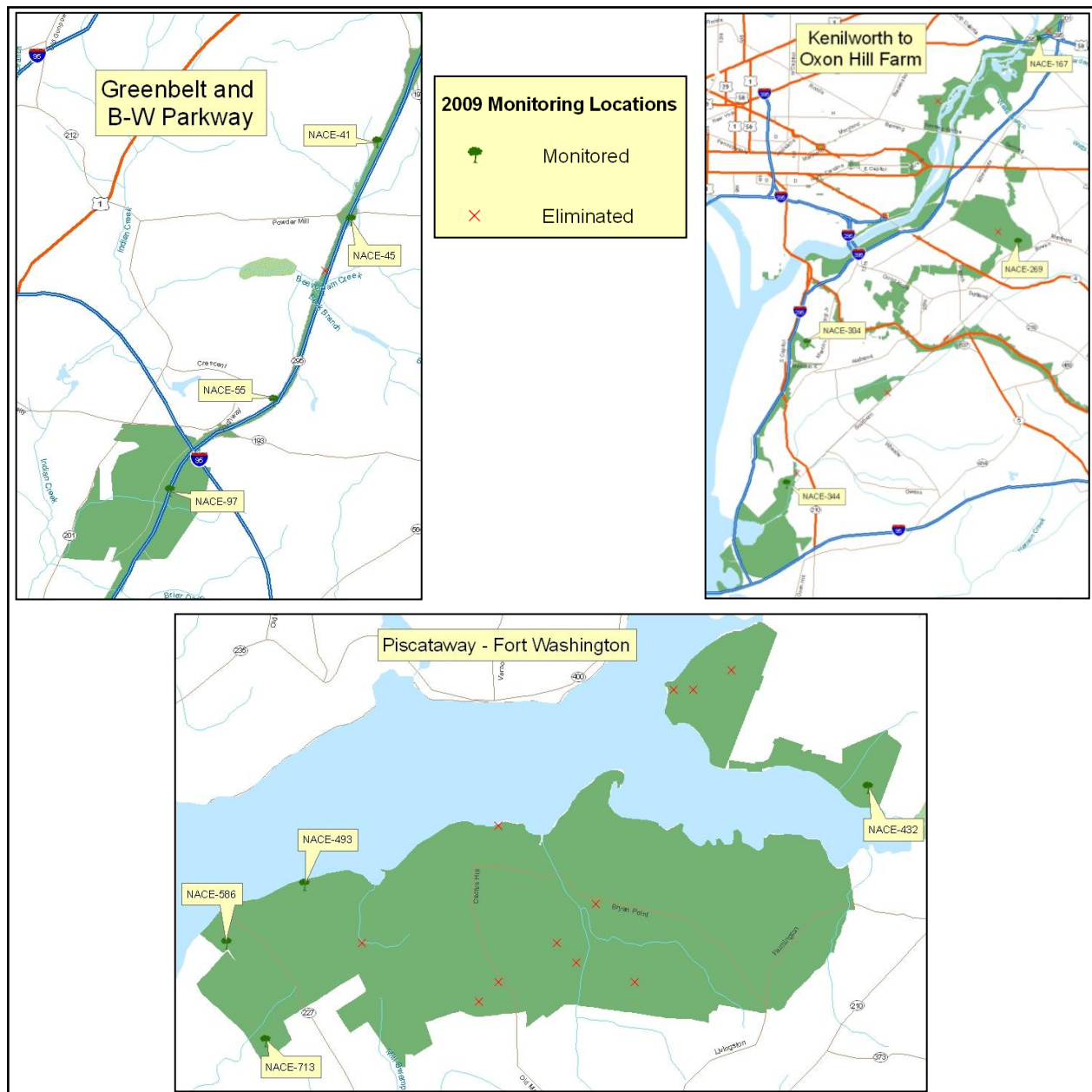


Figure 8. Locations considered for monitoring in National Capital Parks East.

Forest Communities

Tree density and basal area for NACE are presented in Table 61.

Table 61. Density, basal area (BA) and richness of trees, saplings and seedlings in NACE.

Plot	Trees	Trees/ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings/ha	Species
NACE-0041	53	750	263,000	9	9	1060	25,100	4	3	2500	2
NACE-0045	36	509	384,000	4	5	589	22,400	1	7	5830	5
NACE-0055	29	410	341,000	8	-	-	-	-	4	3300	2
NACE-0097	23	325	205,000	8	7	825	17,200	3	5	4170	2
NACE-0167	36	509	162,000	11	13	1530	15,900	6	15	12,500	5
NACE-0269	17	241	422,000	7	8	943	19,400	6	6	5000	4
NACE-0304	26	368	351,000	6	27	3180	14,100	3	17	14,200	1
NACE-0344	20	283	336,000	8	1	118	3340	1	2	1670	2
NACE-0432	21	297	190,000	10	18	2120	24,900	7	12	10,000	4
NACE-0493	16	226	82,200	4	4	472	14,300	3	11	9170	2
NACE-0586	17	241	196,000	5	1	118	6530	1	1	833	1
NACE-0713	51	772	356,000	10	8	943	7650	4	12	10,000	6
Total	345	407	274,000	37	101	992	21,500	21	95	6600	24

Overall, 44 tree species were found on the twelve plots in NACE (Table 62).

Table 62. Tree species found in NACE.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer negundo</i>	box elder	3	1590	2/2	1	305	1
¹ <i>Acer platanoides</i>	Norway maple	3	398	-	-	-	-
<i>Acer rubrum</i>	red maple	67	60,700	35/4	5	1540	1
<i>Acer saccharum</i>	sugar maple	-	-	-	2	432	-
¹ <i>Ailanthus altissima</i>	tree of heaven	-	-	-	1	20	-
<i>Amelanchier arborea</i>	common serviceberry	-	-	-	-	-	3
<i>Asimina triloba</i>	pawpaw	-	-	-	25	796	19
<i>Carpinus caroliniana</i>	American hornbeam	-	-	-	-	-	1
<i>Carya alba</i>	mockernut hickory	3	977	1/-	1	196	-
<i>Carya cordiformis</i>	bitternut hickory	1	2960	1/1	-	-	4
<i>Carya glabra</i>	pignut hickory	1	200	-	2	147	-
<i>Celtis occidentalis</i>	common hackberry	8	4130	6/6	2	727	5
<i>Cercis canadensis</i>	eastern redbud	1	219	-	-	-	-
<i>Cornus florida</i>	flowering dogwood	1	112	-	1	344	-
<i>Fagus grandifolia</i>	American beech	18	6410	1/-	4	599	2
<i>Fraxinus americana</i>	white ash	8	3580	2/2	-	-	1
<i>Fraxinus pennsylvanica</i>	green ash	14	4440	12/-	3	167	4
<i>Fraxinus profunda</i>	pumpkin ash	3	646	3/-	3	314	-
<i>Ilex opaca</i>	American holly	32	5220	3/3	8	2440	8
<i>Juniperus virginiana</i>	eastern red cedar	1	374	1/-	-	-	-
<i>Liquidambar styraciflua</i>	sweetgum	49	30,000	11/-	11	2220	7
<i>Liriodendron tulipifera</i>	tulip poplar	18	51,600	11/-	11	334	-
¹ <i>Malus</i> spp.	apple	-	-	-	1	20	2
¹ <i>Morus alba</i>	white mulberry	2	255	2/-	-	-	-
<i>Nyssa sylvatica</i>	blackgum	36	9860	18/6	9	2710	3
<i>Pinus rigida</i>	pitch pine	1	547	-/-	-	-	-
<i>Pinus virginiana</i>	Virginia pine	5	4320	2/-	-	-	1
<i>Populus deltoides</i>	eastern cottonwood	1	2000	1/-	-	-	-
<i>Prunus serotina</i>	black cherry	4	2690	2/1	4	933	10
¹ <i>Pyrus betulifolia</i>	birch-leaf pear	1	752	1/-	-	-	-
¹ <i>Pyrus calleryana</i>	Callery pear	-	-	-	3	236	7
<i>Quercus alba</i>	white oak	6	5650	-	-	-	1
<i>Quercus coccinea</i>	scarlet oak	7	6110	-	-	-	-
<i>Quercus falcata</i>	southern red oak	4	5450	1/-	-	-	-
<i>Quercus palustris</i>	pin oak	4	5810	4/-	-	-	1
<i>Quercus phellos</i>	willow oak	11	17,900	4/1	-	-	2
<i>Quercus rubra</i>	northern red oak	3	20,600	1/-	-	-	-
<i>Quercus velutina</i>	black oak	4	7100	-	-	-	1
<i>Robinia pseudo- acacia</i>	black locust	3	1000	3/2	-	-	-
<i>Salix nigra</i>	black willow	1	1040	1/-	-	-	-
<i>Sassafras albidum</i>	sassafras	14	6000	13/13	3	265	9
<i>Ulmus americana</i>	American elm	4	1300	4/-	-	-	1
¹ <i>Ulmus pumila</i>	Siberian elm	2	749	2/1	-	-	-
<i>Ulmus rubra</i>	slippery elm	2	1280	1/1	1	608	1

¹Non-native species.

The number and basal area of shrubs varied greatly across NACE (Table 63).

Table 63. Density, basal area, seedling density and richness of shrubs in NACE.

Plot	Shrubs	Shrubs/ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
NACE-0041	1	118	1	2230	-	-
NACE-0045	-	-	-	-	10	8330
NACE-0055	-	-	-	-	-	-
NACE-0097	1	118	1	4940	-	-
NACE-0167	93	11,000	4	240,000	14	11,700
NACE-0269	2	236	2	16,000	3	2500
NACE-0304	-	-	-	-	-	-
NACE-0344	-	-	-	-	2	1670
NACE-0432	1	118	1	7000	-	-
NACE-0493	-	-	-	-	-	-
NACE-0587	-	-	-	-	2	1670
NACE-0713	19	2240	4	505,000	10	8330
Total	117	1150	9	64,600	41	2850

Plot NACE-0167 near the intersection of Route 50 and the Baltimore-Washington Parkway had a very high density of shrubs, particularly Amur honeysuckle (*Lonicera mackii*). Because of this, Amur honeysuckle was the most common shrub found on the plots (Table 64).

Table 64. Shrub species found on forest monitoring plots in NACE.

Latin Name	Common Name	Shrubs	Seedlings
<i>Amelanchier canadensis</i>	Canadian serviceberry	-	11
<i>Cornus amomum</i>	silky dogwood	5	-
¹ <i>Euonymus alatus</i>	burning bush	1	-
<i>Ilex verticillata</i>	common winterberry	3	1
<i>Kalmia latifolia</i>	mountain laurel	1	-
¹ <i>Ligustrum vulgare</i>	European privet	-	1
<i>Lindera benzoin</i>	northern spicebush	2	6
¹ <i>Lonicera maackii</i>	Amur honeysuckle	78	14
<i>Lyonia ligustrina</i>	maleberry	-	5
<i>Vaccinium corymbosum</i>	highbush blueberry	2	-
<i>Vaccinium fuscatum</i>	black highbush blueberry	15	2
<i>Viburnum dentatum</i>	southern arrowwood	10	1

¹Non-native species.

Forest Pests and Diseases

No targeted forest pests or diseases were found in NACE in 2009.

Exotic Plant Species

Exotic Trees

Seven exotic tree species were found (Table 62). They make up 2.3% of all individuals and 0.8% of all basal area in the tree layer, 5.0% of all individuals and 1.3% of all basal area in the sapling layer and are 9.51% of all individuals in the seedling layer.

Vines in Trees

Vines are very common on trees in NACE. Over 43% of all trees have vines in them, and over 12% have vines in their crowns (Table 65). In some of the plots in NACE, nearly every tree had vines.

Table 65. Presence of vines in NACE.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
NACE-0041	53	1	-
NACE-0045	36	17	4
NACE-0055	29	24	2
NACE-0097	23	18	2
NACE-0167	36	34	5
NACE-0269	17	10	-
NACE-0304	26	1	-
NACE-0344	20	1	-
NACE-0432	21	15	13
NACE-0493	16	16	16
NACE-0586	17	12	1
NACE-0713	51	0	-
Total	345	149	43

Roundleaf greenbrier (*Smilax rotundifolia*) was the most common vine but frost grape (*Vitis vulpina*) was the most common vine in the crowns of trees (Table 66).

Table 66. Species of vines in trees in NACE.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Ampelopsis brevipedunculata</i>	porcelainberry	9	2
<i>Apios americana</i>	Groundnut	1	-
<i>Campsis radicans</i>	trumpet creeper	1	1
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	16	16
¹ <i>Clematis terniflora</i>	sweet autumn clematis	4	-
¹ <i>Hedera helix</i>	English ivy	1	-
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	10	4
<i>Parthenocissus quinquefolia</i>	Virginia creeper	15	9
¹ <i>Rosa multiflora</i>	multiflora rose	1	-
<i>Smilax glauca</i>	cat greenbrier	1	-
<i>Smilax rotundifolia</i>	roundleaf greenbrier	74	12
<i>Toxicodendron radicans</i>	poison ivy	57	3
<i>Vitis aestivalis</i>	summer grape	3	3
<i>Vitis cinerea</i>	graybark grape	1	-
<i>Vitis labrusca</i>	fox grape	1	-
<i>Vitis vulpina</i>	frost grape	30	27

¹Non-native species

Exotic Shrubs

Three exotic shrub species were found (Table 64). Amur honeysuckle (*Lonicera maackii*) was by far the most common. Exotics make up 67.5% of all shrubs and 36.6% of all shrub species on the monitoring plots.

Exotic Herbaceous Plants

Eight out of the twelve plots in NACE had exotic herbaceous species (Table 67).

Table 67. Frequency of exotic herbaceous plants in NACE.

Park	Quadrats with exotics	Number of exotic species
NACE-0041	-	-
NACE-0045	-	-
NACE-0055	-	-
NACE-0097	8	3
NACE-0167	10	5
NACE-0269	12	2
NACE-0304	1	1
NACE-0344	11	5
NACE-0432	12	4
NACE-0493	12	7
NACE-0586	12	4
NACE-0713	-	-
Total		13

Most exotics species had a fairly low percent cover (Table 68), except for garlic mustard (*Alliaria petiolata*), Oriental bittersweet (*Celastrus orbiculatus*), ground ivy (*Glechoma hederacea*) and Japanese stiltgrass (*Microstegium vimineum*).

Table 68. Cover of exotic herbaceous plants in NACE.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	2	10%
<i>Ampelopsis brevipedunculata</i>	porcelain berry	2	2%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	4	14%
<i>Clematis terniflora</i>	sweet autumn clematis	1	2%
<i>Duchesnea indica</i>	Indian strawberry	2	1%
<i>Glechoma hederacea</i>	ground ivy	1	21%
<i>Hedera helix</i>	English ivy	2	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	7	5%
<i>Microstegium vimineum</i>	Japanese stiltgrass	5	10%
<i>Polygonum caespitosum</i>	Oriental ladythumb	1	<1%
<i>Polygonum perfoliatum</i>	Mile-a-minute	1	<1%
<i>Rosa multiflora</i>	multiflora rose	2	<1%
<i>Rubus phoenicolasius</i>	wineberry	1	<1%

Prince William Forest Park

Forty-four plots were monitored in Prince William in 2009. The plots were located throughout the park (Figure 9).

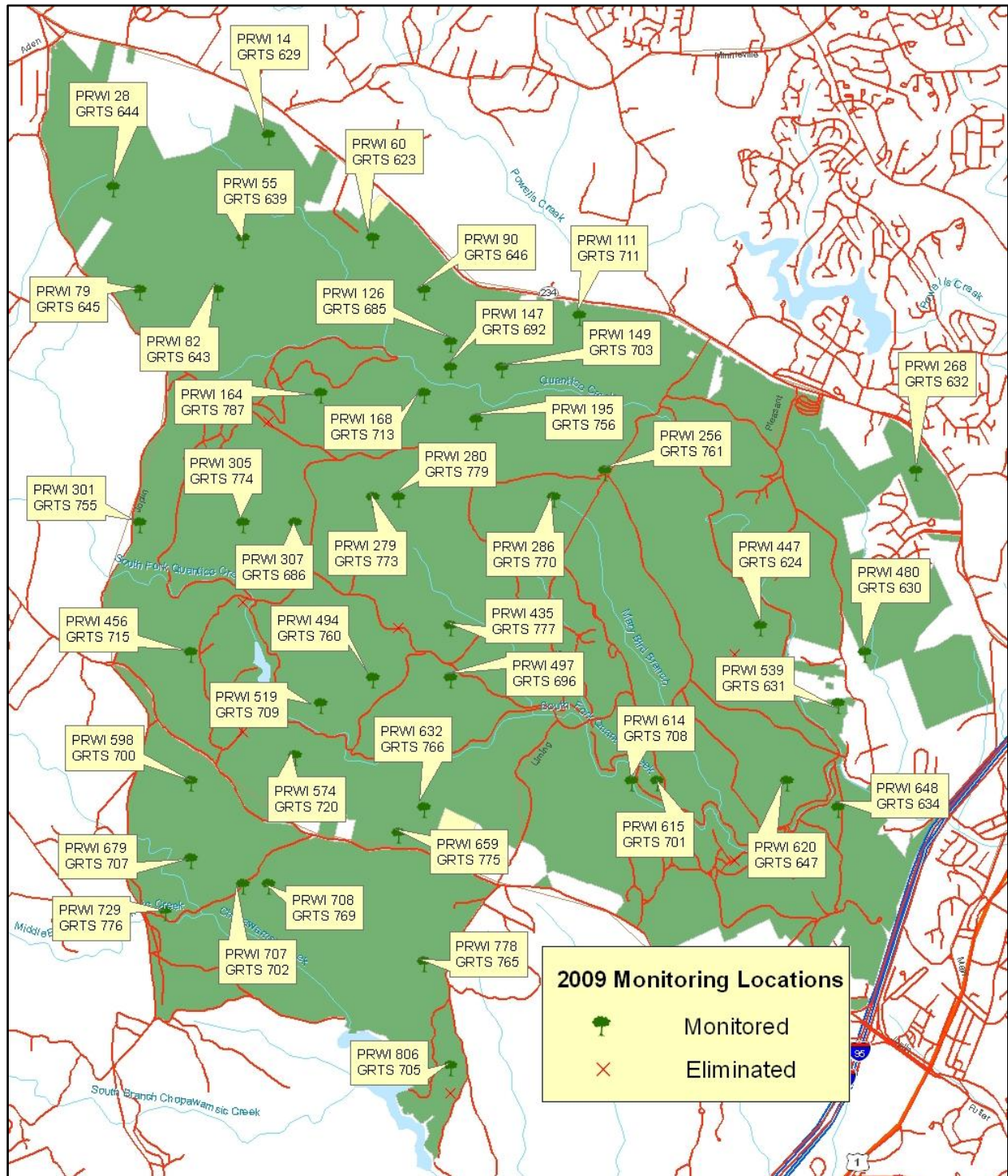


Figure 9. Locations considered for forest monitoring in Prince William.

Forest Communities

Tree sapling density and seedling densities were higher than the regional averages. All but four of the plots in Prince William had tree seedlings (Table 69), suggesting higher tree regeneration than in most other parks.

Table 69. Density, basal area (BA) and richness of trees, saplings, and seedlings in Prince William.

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Species
PRWI-0014	28	396	244,000	9	12	1420	47,800	2	-	-	-
PRWI-0028	30	424	364,000	4	5	589	22,600	2	26	21,700	5
PRWI-0055	46	651	191,000	7	8	943	23,200	3	-	-	-
PRWI-0060	29	410	305,000	8	12	1420	38,700	2	5	4170	3
PRWI-0079	49	693	411,000	9	10	1180	24,600	4	4	3330	3
PRWI-0082	32	453	319,000	12	12	1420	33,900	6	6	5000	2
PRWI-0090	36	509	202,000	5	12	1420	26,400	2	-	-	-
PRWI-0111	25	354	124,000	8	1	118	7840	1	2	1670	2
PRWI-0126	37	523	201,000	11	20	2360	31,000	6	8	6670	4
PRWI-0147	49	693	201,000	8	13	1530	27,400	5	1	833	1
PRWI-0149	26	368	202,000	12	13	1530	29,400	7	4	3330	2
PRWI-0164	39	552	263,000	7	8	943	18,300	3	1	833	1
PRWI-0168	11	156	151,000	5	12	1420	4350	1	3	2500	2
PRWI-0195	28	396	358,000	9	8	943	11,200	3	2	1670	1
PRWI-0256	50	707	412,000	4	29	3420	27,200	9	13	10,800	5
PRWI-0268	52	736	365,000	10	9	1060	19,000	4	4	3330	2
PRWI-0279	55	778	317,000	7	10	1180	20,200	4	9	7500	3
PRWI-0280	41	580	253,000	9	1	118	5710	1	2	1670	1
PRWI-0286	37	523	345,000	7	16	1890	22,700	7	9	7500	6
PRWI-0301	46	651	335,000	9	25	2950	40,800	10	16	13,300	7
PRWI-0305	39	552	316,000	7	11	1300	37,800	4	8	6670	4
PRWI-0307	33	467	227,000	7	8	943	24,000	6	6	5000	1
PRWI-0435	38	538	353,000	4	4	472	3480	2	3	2500	2
PRWI-0447	21	297	352,000	10	5	589	7830	3	3	2500	2
PRWI-0456	42	594	153,000	9	47	5540	39,300	6	17	14,200	3
PRWI-0480	28	396	344,000	6	2	236	4,260	2	4	3330	3
PRWI-0494	33	467	243,000	11	34	4010	21,800	3	30	25,000	3
PRWI-0497	33	467	247,000	8	10	1180	13,900	4	4	3330	2
PRWI-0519	30	424	315,000	9	10	1180	17,000	7	13	10,800	7
PRWI-0539	28	396	289,000	6	5	589	13,200	3	1	833	1
PRWI-0574	44	622	307,000	13	3	354	10,400	2	-	-	-
PRWI-0598	20	283	262,000	6	6	707	27,400	1	5	4170	1
PRWI-0614	29	410	358,000	7	4	472	9370	1	4	3330	2
PRWI-0615	44	622	352,000	10	6	707	17,800	1	8	6670	2
PRWI-0620	23	325	267,000	6	7	825	27,800	2	3	2500	1
PRWI-0632	38	538	298,000	8	3	354	6630	2	2	1670	2

Table 69. Density, basal area (BA) and richness of trees, saplings, and seedlings in Prince William (continued).

Plot	Trees	Trees/ ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Species
PRWI-0648	68	962	414,000	7	10	1180	22,700	3	3	1670	1
PRWI-0659	49	693	355,000	4	17	2000	14,400	5	3	2500	2
PRWI-0679	80	1130	358,000	4	7	825	16,600	3	6	5000	4
PRWI-0707	20	283	311,000	3	2	236	3370	2	16	13,300	5
PRWI-0708	38	538	346,000	8	11	1300	38,000	4	12	10000	4
PRWI-0729	27	382	176,000	8	4	472	16,500	3	24	20,000	6
PRWI-0778	40	566	337,000	10	19	332	39,100	3	3	2500	2
PRWI-0806	29	410	360,000	8	10	1180	20,300	4	5	4170	2
Total	1620	521	912,000	29	481	1290	21,300	20	297	5620	21

Thirty-three different tree species were found in Prince William (Table 70).

Table 70. Tree species found in Prince William.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/in crown	Saplings	Sapling BA cm ² /ha	Seedlings
<i>Acer rubrum</i>	red maple	171	14,400	16/8	31	2560	2
¹ <i>Ailanthus altissima</i>	tree of heaven	1	26	-	-	-	-
<i>Amelanchier arborea</i>	common serviceberry	-	-	-	-	-	7
<i>Asimina triloba</i>	pawpaw	-	-	-	-	-	6
<i>Betula nigra</i>	river birch	-	-	-	-	-	1
<i>Carpinus caroliniana</i>	American hornbeam	1	28	-	14	579	5
<i>Carya alba</i>	mockernut	13	1870	-	1	70	1
	hickory						
<i>Carya glabra</i>	pignut hickory	34	5130	1/-	6	383	7
<i>Carya ovalis</i>	red hickory	7	1750	-	1	5	-
<i>Cornus florida</i>	flowering dogwood	23	774	2/2	25	1390	-
<i>Fagus grandifolia</i>	American beech	247	27,100	14/2	155	6340	27
<i>Fraxinus americana</i>	white ash	4	231	-	-	-	-
<i>Ilex opaca</i>	American holly	33	1490	10/8	50	2030	53
<i>Juniperus virginiana</i>	eastern red cedar	9	501	6/3	1	64	2
<i>Liquidambar styraciflua</i>	sweetgum	7	1330	1/-	9	150	11
<i>Liriodendron tulipifera</i>	tulip poplar	326	67,200	6/-	7	678	-
<i>Nyssa sylvatica</i>	blackgum	104	6340	3/1	67	4840	4
<i>Pinus echinata</i>	shortleaf pine	1	233	-	-	-	-
<i>Pinus virginiana</i>	Virginia pine	310	68,300	32/2	1	72	6
<i>Populus grandidentata</i>	bigtooth aspen	7	2370	-	-	-	-
<i>Prunus serotina</i>	black cherry	5	529	4/4	-	-	3
¹ <i>Pryus communis</i>	common pear	1	68	1/-	-	-	-
<i>Quercus alba</i>	white oak	167	38,300	5/-	78	935	104
<i>Quercus coccinea</i>	scarlet oak	45	18,200	-	4	72	7
<i>Quercus falcata</i>	southern red oak	36	11,100	1/1	17	188	15
<i>Quercus phellos</i>	willow oak	-	-	-	1	198	-
<i>Quercus prinus</i>	chestnut oak	9	3080	1/-	1	11	3
<i>Quercus rubra</i>	northern red oak	32	13300	-	1	11	3
<i>Quercus velutina</i>	black oak	21	7950	1/-	9	324	22
<i>Quercus X benderi</i>	Bender's oak	1	408	-	-	-	-
<i>Quercus X willdenowiana</i>	Willdenow's oak	1	704	-	-	-	-
<i>Quercus spp.</i>	oak	1	422	-	-	-	-
<i>Sassafras albidum</i>	sassafras	3	107	-	-	-	-

Shrubs were scattered in Prince William (Table 71).

Table 71. Density, basal area, seedling density and richness of shrubs in Prince William.

Plot	Shrubs	Shrubs per ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
PRWI-0014	-	-	-	-	-	-
PRWI-0028	1	118	1	130	-	-
PRWI-0055	-	-	-	-	-	-
PRWI-0060	2	236	1	32,200	-	-
PRWI-0079	-	-	-	-	-	-
PRWI-0082	-	-	-	-	-	-
PRWI-0090	-	-	-	-	-	-
PRWI-0111	-	-	-	-	-	-
PRWI-0126	-	-	-	-	-	-
PRWI-0147	-	-	-	-	-	-
PRWI-0149	-	-	-	-	-	-
PRWI-0164	-	-	-	-	-	-
PRWI-0168	-	-	-	-	2	1670
PRWI-0195	-	-	-	-	-	-
PRWI-0256	2	236	1	1670	-	-
PRWI-0268	-	-	-	-	22	18,300
PRWI-0279	14	1650	2	5880	5	4170
PRWI-0280	-	-	-	-	-	-
PRWI-0286	26	3060	3	38,000	-	-
PRWI-0301	-	-	-	-	-	-
PRWI-0305	-	-	-	-	1	833
PRWI-0307	-	-	-	-	-	-
PRWI-0435	-	-	-	-	-	-
PRWI-0447	-	-	-	-	-	-
PRWI-0456	2	236	2	2710	1	833
PRWI-0480	1	118	1	2040	-	-
PRWI-0494	5	589	2	16,300	2	1670
PRWI-0497	3	354	2	107,000	-	-
PRWI-0519	74	8720	2	269,000	2	1670
PRWI-0539	-	-	-	-	-	-
PRWI-0574	-	-	-	-	1	833
PRWI-0598	20	2360	1	789,000	-	-
PRWI-0614	-	-	-	-	-	-
PRWI-0615	-	-	-	-	-	-
PRWI-0620	-	-	-	-	-	-
PRWI-0632	-	-	-	-	-	-
PRWI-0648	-	-	-	-	1	833
PRWI-0659	4	472	1	19,200	-	-
PRWI-0679	3	354	2	1870	-	-
PRWI-0707	22	2590	3	70,700	13	10,800
PRWI-0708	-	-	-	-	10	8330
PRWI-0729	20	2360	4	243,000	11	9170
PRWI-0778	-	-	-	-	1	833
PRWI-0806	36	4240	1	142,000	2	1670
Total	235	630	7	39,500	74	1400

Ten species of shrubs were found in the microplots (Table 72). Mountain laurel (*Kalmia latifolia*) was by far the most common.

Table 72. Shrub species found in Prince William.

Latin Name	Common Name	Shrubs	Seedlings
<i>Aralia spinosa</i>	devil's walkingstick	1	1
¹ <i>Elaeagnus umbellata</i>	autumn olive	1	-
<i>Euonymus americanus</i>	strawberry bush	-	3
<i>Hamamelis virginiana</i>	American witchhazel	2	5
<i>Kalmia latifolia</i>	mountain laurel	170	16
<i>Lyonia ligustrina</i>	maleberry	1	19
<i>Rhododendron periclymenoides</i>	pinxter flower	-	1
<i>Vaccinium corymbosum</i>	highbush blueberry	33	1
<i>Vaccinium fuscatum</i>	black highbush blueberry	27	26
<i>Viburnum prunifolium</i>	blackhaw	-	2

Forest Pests and Diseases

Dogwood anthracnose was found on a single tree in Prince William in 2009. The infected dogwood (*Cornus florida*) tree was found on plot PRWI-0014 in the northwest corner of the park.

Exotic Plant Species

Exotic Trees

Two exotic trees were found in Prince William, one tree of heaven (*Ailanthus altissima*) and one common pear (*Pyrus communis*). These two trees comprise 0.1% of all individual trees and 0.03% of all tree basal area. No exotics are present as saplings or tree seedlings.

Vines on Trees

Relatively few trees have vines growing on them, and less than 2% have vines in their crown. (Table 73).

Table 73. Presence of vines in Prince William.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
PRWI-0014	28	-	-
PRWI-0028	30	-	-
PRWI-0055	46	1	-
PRWI-0060	29	1	-
PRWI-0079	49	-	-
PRWI-0082	32	3	-
PRWI-0090	36	2	-
PRWI-0111	25	23	17
PRWI-0126	37	1	-
PRWI-0147	49	-	-
PRWI-0149	26	-	-
PRWI-0164	39	15	4
PRWI-0168	11	-	-
PRWI-0195	28	1	-
PRWI-0256	50	6	-
PRWI-0268	52	-	-
PRWI-0279	55	2	-
PRWI-0280	41	3	-
PRWI-0286	37	5	-
PRWI-0301	46	-	-
PRWI-0305	39	1	-
PRWI-0307	33	1	-
PRWI-0435	38	4	1
PRWI-0447	21	-	-
PRWI-0456	42	13	9
PRWI-0480	28	-	-
PRWI-0494	33	-	-
PRWI-0497	33	-	-
PRWI-0519	30	-	-
PRWI-0539	28	-	-
PRWI-0574	44	-	-
PRWI-0598	20	2	-
PRWI-0614	29	-	-
PRWI-0615	44	-	-
PRWI-0620	23	-	-
PRWI-0632	38	-	-
PRWI-0648	68	-	-
PRWI-0659	49	16	-
PRWI-0679	80	-	-
PRWI-0707	20	1	-
PRWI-0708	38	-	-
PRWI-0729	27	-	-
PRWI-0778	40	1	-
PRWI-0806	29	-	-
Total	1620	104	31

Most of the vines that are growing on trees are *Smilax* species (Table 74).

Table 74. Species of vines in trees in Prince William.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	3	2
<i>Parthenocissus quinquefolia</i>	Virginia creeper	5	2
<i>Smilax rotundifolia</i>	greenbrier	79	14
<i>Toxicodendron radicans</i>	poison ivy	5	2
<i>Vitis aestivalis</i>	summer grape	2	1
<i>Vitis labrusca</i>	fox grape	11	10
<i>Vitis vulpina</i>	Frost grape	9	8

¹Non-native species.

Exotic Shrubs

The only exotic shrub found was a single individual of autumn olive (*Elaeagnus umbellata*). This shrub represents 0.4% of all individual shrubs found. No exotic shrub seedlings were monitored in Prince William in 2009.

Exotic Herbaceous Plants

Few of the plots at Prince William had exotic herbaceous plants present (Table 75).

Table 75. Presence of exotic herbaceous plants in Prince William.

Plot	Quadrats with Exotics	Number of Exotic Species
PRWI-0014	-	-
PRWI-0028	-	-
PRWI-0055	5	1
PRWI-0060	-	-
PRWI-0079	-	-
PRWI-0082	-	-
PRWI-0090	-	-
PRWI-0111	12	2
PRWI-0126	4	2
PRWI-0147	-	-
PRWI-0149	-	-
PRWI-0164	-	-
PRWI-0168	-	-
PRWI-0195	-	-
PRWI-0256	-	-
PRWI-0268	-	-
PRWI-0279	-	-
PRWI-0280	-	-
PRWI-0286	-	-
PRWI-0301	-	-
PRWI-0305	-	-
PRWI-0307	-	-
PRWI-0435	5	1
PRWI-0447	-	-
PRWI-0456	-	-
PRWI-0480	1	2
PRWI-0494	-	-
PRWI-0497	-	-
PRWI-0519	-	-
PRWI-0539	-	-
PRWI-0574	-	-
PRWI-0598	-	-
PRWI-0614	-	-
PRWI-0615	-	-
PRWI-0620	2	1
PRWI-0632	-	-
PRWI-0648	-	-
PRWI-0659	-	-
PRWI-0679	-	-
PRWI-0707	5	2
PRWI-0708	-	-
PRWI-0729	1	1
PRWI-0778	-	-
PRWI-0806	-	-
Total		4

Only four species were found (Table 76). Japanese honeysuckle (*Lonicera japonica*) was the most widespread and Japanese stiltgrass (*Microstegium vimineum*) had the highest percent cover.

Table 76. Cover of exotic herbaceous plants in Prince William.

Latin name	Common name	Plots	Mean % cover when present
<i>Hedera helix</i>	English ivy	1	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	7	<1%
<i>Microstegium vimineum</i>	Japanese stiltgrass	3	22%
<i>Rubus phoenicolasius</i>	wineberry	1	<1%

Rock Creek Park

Seven forest plots were monitored in Rock Creek in 2009 (Figure 10).

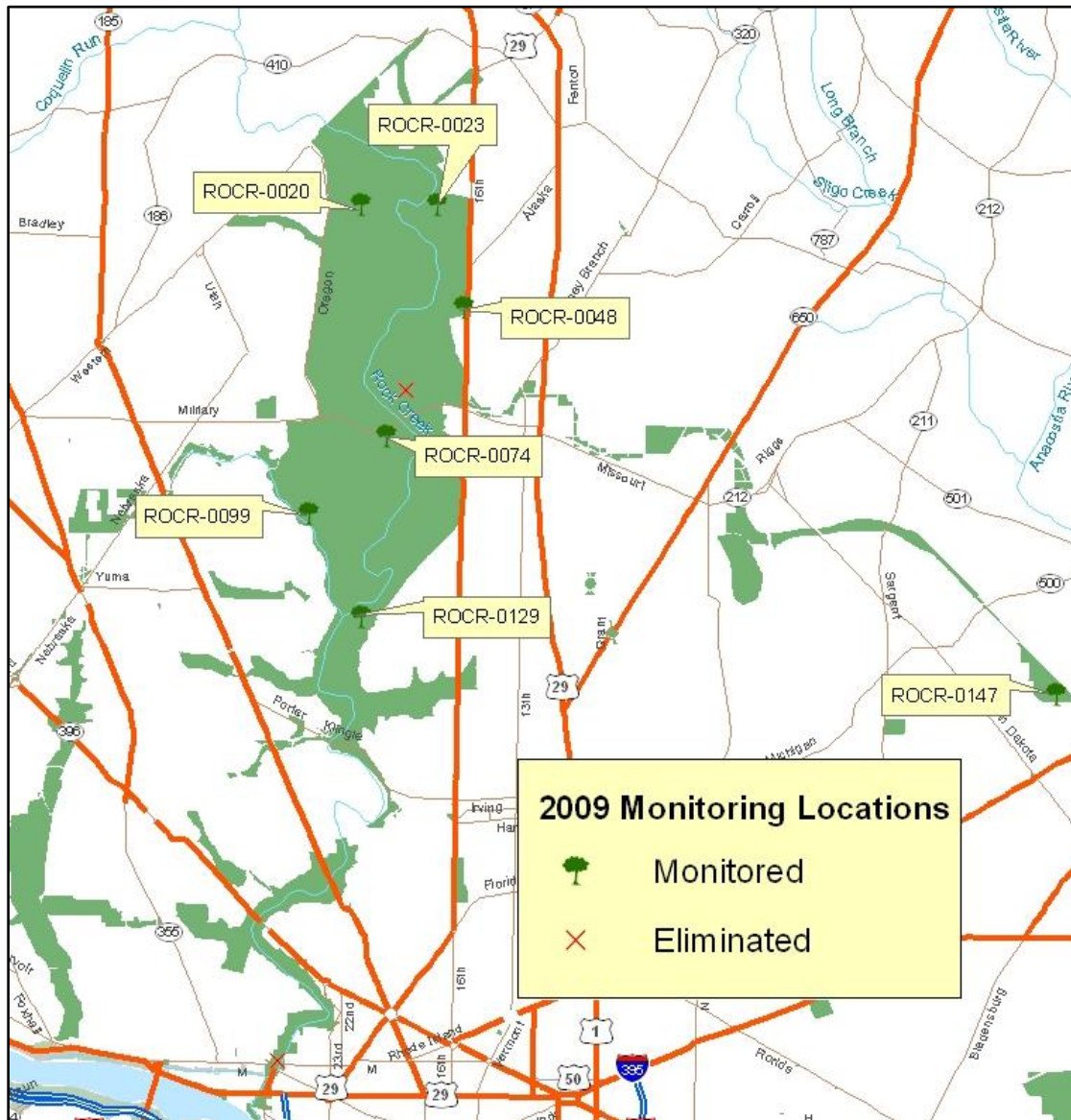


Figure 10. Locations considered for monitoring in Rock Creek.

Forest Communities

Information on tree density and basal area is reported in Table 77. Twenty nine tree species were found in Rock Creek (Table 78).

Table 77. Density, basal area (BA) and richness of trees saplings and seedlings in Rock Creek.

Plot	Trees	Trees /ha	Tree BA(cm ²)/ha	Tree Species	Saplings	Saplings/ ha	Sapling BA(cm ²)/ha	Sapling Species	Seedlings	Seedlings /ha	Species
ROCR-0020	19	269	244,000	7	13	1530	11,900	5	-	-	-
ROCR-0023	19	269	589,000	7	16	1890	31,900	5	5	4170	5
ROCR-0048	19	269	345,000	10	5	589	10,200	4	6	5000	3
ROCR-0074	26	368	332,000	12	5	589	24,200	4	1	833	1
ROCR-0099	23	325	458,000	6	9	1060	31,700	4	3	2500	3
ROCR-0129	22	311	444,000	6	9	1060	16,100	5	2	1670	2
ROCR-0147	20	283	287,000	8	9	1060	17,700	5	-	-	-
Total	148	299	386,000	22	66	1110	20,500	18	17	2020	12

Table 78. Tree species found in Rock Creek.

Latin Name	Common Name	Trees	Tree BA cm ² /ha	Trees with vines/ in crown	Saplings	Sapling BA cm ² /ha	Seedlings
¹ <i>Acer</i>	Norway	3	1150	1/1	1	67	-
<i>platanooides</i>	maple						
<i>Acer rubrum</i>	red maple	18	17,700	4/2	10	5880	-
¹ <i>Ailanthus</i>	tree of heaven	2	869	2/0	-	-	-
<i>altissima</i>							
<i>Carpinus</i>	American	-	-	-	3	657	-
<i>caroliniana</i>	hornbeam						
<i>Carya alba</i>	mockernut	13	1520	-	2	51	1
	hickory						
<i>Carya</i>	bitternut	-	-	-	-	-	1
<i>cordiformis</i>	hickory						
<i>Carya glabra</i>	pignut hickory	1	562	-	2	84	1
<i>Carya ovalis</i>	red hickory	2	604	-	1	17	-
<i>Cercis</i>	eastern redbud	-	-	-	-	-	1
<i>canadensis</i>							
<i>Cornus florida</i>	flowering	-	-	-	2	876	-
	dogwood						
<i>Diospyros</i>	common	1	719	1/-	-	-	-
<i>virginiana</i>	persimmon						
<i>Fagus</i>	American	17	25,200	2/1	26	4130	2
<i>grandifolia</i>	beech						
<i>Fraxinus</i>	white ash	1	172	-	3	1570	1
<i>americana</i>							
<i>Ilex opaca</i>	American	1	315	-	2	354	-
	holly						
<i>Liriodendron</i>	tulip poplar	19	105,000	3/-	-	-	-
<i>tulipifera</i>							
<i>Nyssa sylvatica</i>	blackgum	22	10,700	6/6	5	2760	-
<i>Pinus rigida</i>	pitch pine	1	3810	-	-	-	-
<i>Pinus virginiana</i>	Virginia pine	5	12,400	4/-	-	-	-
¹ <i>Prunus avium</i>	sweet cherry	-	-	-	1	539	-
<i>Prunus serotina</i>	black cherry	4	5720	3/1	2	825	2
<i>Quercus alba</i>	white oak	25	134,000	6/2	1	573	1
<i>Quercus falcata</i>	southern red	2	11,300	2/-	-	-	-
	oak						
<i>Quercus</i>	pin oak	-	-	-	1	51	-
<i>palustris</i>							
<i>Quercus phellos</i>	willow oak	2	685	2/-	1	101	-
<i>Quercus prinus</i>	chestnut oak	6	8190	-	-	-	-
<i>Quercus rubra</i>	northern red	6	30,100	-	2	1380	3
	oak						
<i>Quercus</i>	black oak	4	13,400	-	-	-	1
<i>velutina</i>							
<i>Sassafras</i>	sassafras	3	944	2/2	-	-	1
<i>albidum</i>							
<i>Ulmus</i>	American elm	-	-	-	1	589	2
<i>americana</i>							

¹Non-native species.

All but one of the 11 shrubs found in Rock Creek occurred on plot ROCR-0048, on the eastern boundary of the main section of the park (Table 79).

Table 79. Density, basal area, seedling density and richness of shrubs in Rock Creek.

Plot	Shrubs	Shrubs/ha	Species	BA(cm ²)/ha	Seedlings	Seedlings/ha
ROCR-0020	-	-	-	-	-	-
ROCR-0023	-	-	-	-	17	14,200
ROCR-0048	10	1180	1	109,000	22	18,300
ROCR-0074	-	-	-	-	1	833
ROCR-0099	-	-	-	-	1	833
ROCR-0129	1	118	1	6680	2	1670
ROCR-0147	-	-	-	-	-	-
Total	11	185	2	16,500	43	5120

Five shrub species were found (Table 80). Northern spicebush (*Lindera benzoin*) was the most common as a shrub, and mapleleaf viburnum (*Viburnum acerifolium*) was the most common in the seedling layer.

Table 80. Shrubs found in Rock Creek.

Latin Name	Common Name	Shrubs	Seedlings
¹ <i>Euonymus alatus</i>	burning bush	-	1
<i>Kalmia latifolia</i>	mountain laurel	1	-
<i>Lindera benzoin</i>	northern spicebush	10	13
<i>Viburnum acerifolium</i>	mapleleaf viburnum	-	28
<i>Viburnum prunifolium</i>	blackhaw	-	1

¹Non-native species.

Forest Pests and Diseases

No targeted forest pests or diseases were found on the monitoring plots in Rock Creek in 2009.

Exotic Plant Species

Exotic Trees

Three exotic tree species (Table 78) were found in Rock Creek. They make up 3.4% of all individuals and 1.1% of all basal area in the tree layer, 3.0% of all individuals and 2.9% of all basal area in the sapling layer, but are absent from the seedling layer.

Vines in Trees

Over one fourth of trees had vines growing on them; though in a few cases did they reach the tree crowns (Table 81).

Table 81. Presence of vines in Rock Creek.

Plot	Trees	Trees with Vines	Trees with Vines in Crown
ROCR-0020	19	-	-
ROCR-0023	19	2	-
ROCR-0048	19	12	10
ROCR-0074	26	-	-
ROCR-0099	23	2	2
ROCR-0129	22	2	-
ROCR-0147	20	20	3
Total	148	38	15

Most of the vines found in Rock Creek were native (Table 82) Roundleaf greenbrier (*Smilax rotundifolia*) was the most common.

Table 82. Species of vines in trees in Rock Creek.

Latin Name	Common Name	Trees with Vines	Tree with vines in crown
¹ <i>Celastrus orbiculatus</i>	Oriental bittersweet	7	6
¹ <i>Hedera helix</i>	English ivy	1	-
¹ <i>Lonicera japonica</i>	Japanese honeysuckle	2	1
<i>Parthenocissus quinquefolia</i>	Virginia creeper	2	-
<i>Smilax glauca</i>	cat greenbrier	1	-
<i>Smilax rotundifolia</i>	roundleaf greenbrier	20	3
<i>Toxicodendron radicans</i>	poison ivy	6	1
<i>Vitis aestivalis</i>	summer grape	14	13

¹Non-native species.

Exotic Shrubs

The only exotic shrub monitored on the plots was a single seedling of burning bush (*Euonymus alatus* - Table 80).

Exotic Herbaceous Plants

All seven plots in Rock Creek had exotic herbaceous species (Table 83).

Table 83. Presence of exotic herbaceous plants in Rock Creek.

Plot	Quadrats with Exotics	Number of Exotic Species
ROCR-0020	5	4
ROCR-0023	12	4
ROCR-0048	11	7
ROCR-0074	2	1
ROCR-0099	7	2
ROCR-0129	2	1
ROCR-0147	7	3
Total		10

Ten exotic herbaceous layer species were present, of which Japanese barberry (*Berberis thunbergii*) had the highest percent cover (Table 84).

Table 84. Cover of exotic herbaceous plants in Rock Creek.

Latin name	Common name	Plots	Mean % cover when present
<i>Alliaria petiolata</i>	garlic mustard	1	<1%
<i>Berberis thunbergii</i>	Japanese barberry	2	6%
<i>Celastrus orbiculatus</i>	Oriental bittersweet	4	3%
<i>Clematis terniflora</i>	sweet autumn clematis	1	2%
<i>Duchesnea indica</i>	Indian strawberry	1	<1%
<i>Hedera helix</i>	English ivy	2	<1%
<i>Lonicera japonica</i>	Japanese honeysuckle	4	4%
<i>Microstegium vimineum</i>	Japanese stiltgrass	1	<1%
<i>Rubus phoenicolasius</i>	wineberry	1	3%
<i>Viburnum dilatatum</i>	linden arrowwood	5	<1%

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Appendix A. Forest Pests and Diseases Targeted for Monitoring in 2009.

Pest or Disease	Scientific Name	Year Monitoring Began
Beech bark disease	<i>Nectria</i> spp.	2006
Butternut canker	<i>Sirococcus clavigignenti-juglandacearum</i>	2006
Dogwood anthracnose	<i>Discula</i> sp.	2008
Emerald ash borer	<i>Agrilus planipennis</i>	2009
Gypsy moth	<i>Lymantria dispar</i>	2006
Elongate hemlock scale	<i>Fiorinia externa</i>	2008
Hemlock wooly adelgid	<i>Adelges tsugae</i>	2006
Other significant insect damage		2006

Note: Spruce budworm (*Choristoneura* spp.) was previously listed as a target forest pest. However no spruce trees have been encountered on the forest monitoring plots, so spruce budworm has been removed from the target list.

Appendix B. Woody Plants Monitored as Shrubs in 2009.

Latin Name	Common Name	Year added
<i>Alnus serrulata</i>	hazel alder	2008
<i>Amelanchier canadensis</i>	Canadian serviceberry	2009
<i>Castanea pumila</i>	chinkapin	2008
<i>Cornus amomum</i>	silky dogwood	2008
<i>Clethra</i> spp.	sweet pepper bush	2006
<i>Elaeagnus umbellata</i>	autumn olive	2006
<i>Euonymus alatus</i>	burning bush	2006
<i>Euonymus americanus</i>	strawberry bush	2007
<i>Euonymus atropurpureus</i>	wahoo	2007
<i>Gaylussacia frondosa</i>	blue huckleberry	2007
<i>Hamamelis virginiana</i>	American witch-hazel	2006
<i>Ilex verticillata</i>	common winterberry	2006
<i>Kalmia latifolia</i>	mountain laurel	2006
<i>Ligustrum obtusifolium</i>	border privet	2006
<i>Ligustrum ovalifolium</i>	California privet	2008
<i>Ligustrum vulgare</i>	European privet	2008
<i>Lindera benzoin</i>	northern spicebush	2006
<i>Lonicera maackii</i>	Amur honeysuckle	2006
<i>Lonicera morrowii</i>	Morrow's honeysuckle	2008
<i>Lyonia ligustrina</i>	maleberry	2007
<i>Rhododendron periclymenoides</i>	pinxter flower	2007
<i>Rhus copallina</i>	shining sumac	2008
<i>Rhus</i> spp.	sumac	2006
<i>Rosa carolina</i>	Carolina rose	2008
<i>Rubus argutus</i>	sawtooth blackberry	2007
<i>Sambucus canadensis</i>	American black elderberry	2008
<i>Sambucus pubens</i>	red elderberry	2007
<i>Staphylea trifolia</i>	American bladdernut	2006
<i>Symphoricarpos orbiculatus</i>	coralberry	2006
<i>Vaccinium corymbosum</i>	highbush blueberry	2006
<i>Vaccinium fuscum</i>	black highbush blueberry	2007
<i>Vaccinium stamineum</i>	deerberry	2006
<i>Viburnum acerifolium</i>	mapleleaf viburnum	2006
<i>Viburnum dentatum</i>	southern arrowwood	2006
<i>Viburnum dilatatum</i>	linden arrowwood	2008
<i>Viburnum plicatum</i>	Japanese snowball	2007
<i>Viburnum prunifolium</i>	blackhaw	2007
<i>Viburnum sieboldii</i>	Siebold's arrowwood	2007

Appendix C. Exotic Invasive Understory Plants Monitored in 2009.

Latin Name	Common Name	Year Added
<i>Akebia quinata</i>	chocolate vine	2006
<i>Alliaria petiolata</i>	garlic mustard	2006
<i>Ampelopsis brevipedunculata</i>	porcelainberry	2006
<i>Berberis thunbergii</i>	Japanese barberry	2006
<i>Celastrus orbiculatus</i>	oriental bittersweet	2006
<i>Centaurea biebersteinii</i>	spotted knapweed	2006
<i>Cirsium arvense</i>	Canada thistle	2006
<i>Clematis terniflora</i>	sweet autumn clematis	2006
<i>Duchesnea indica</i>	Indian strawberry	2006
<i>Euonymus fortunei</i>	winter creeper	2006
<i>Glechoma hederacea</i>	ground ivy	2006
<i>Hedera helix</i>	English ivy	2006
<i>Hemerocallis fulva</i>	orange day lily	2006
<i>Lespedeza cuneata</i>	Chinese lespedeza	2006
<i>Lonicera japonica</i>	Japanese honeysuckle	2006
<i>Lonicera</i> spp.	honeysuckle	2006
<i>Lysimachia nummularia</i>	creeping jenny	2008
<i>Microstegium vimineum</i>	Japanese stiltgrass	2006
<i>Murdannia keisak</i>	marsh dewflower	2009
<i>Oplismenus undulatifolius</i>	wavyleaf basket grass	2009
<i>Polygonum caespitosum</i>	Oriental ladythumb	2008
<i>Polygonum cuspidatum</i>	Japanese knotweed	2006
<i>Polygonum perfoliatum</i>	mile-a-minute	2006
<i>Polygonum persicaria</i>	Asiatic tearthumb	2008
<i>Pueraria montana</i>	kudzu	2006
<i>Ranunculus ficaria</i>	fig buttercup	2006
<i>Rosa multiflora</i>	multiflora rose	2006
<i>Rubus phoenicolasius</i>	wineberry	2006
<i>Vinca minor</i>	common periwinkle	2006
<i>Wisteria sinensis</i>	Chinese wisteria	2006

